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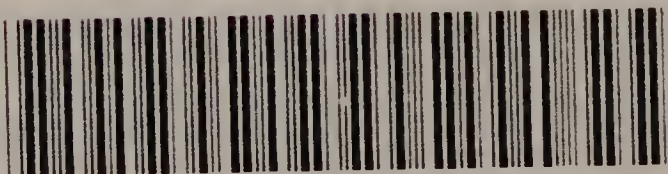
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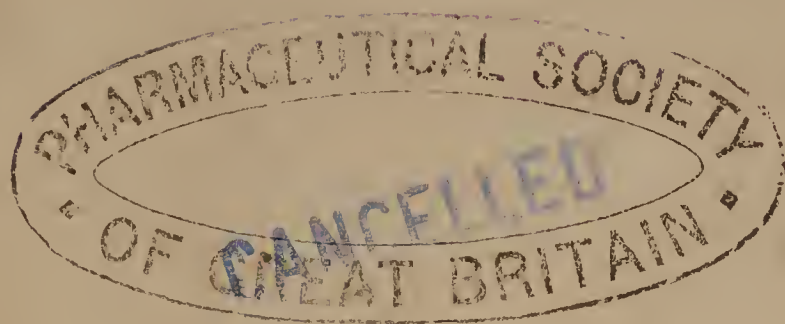
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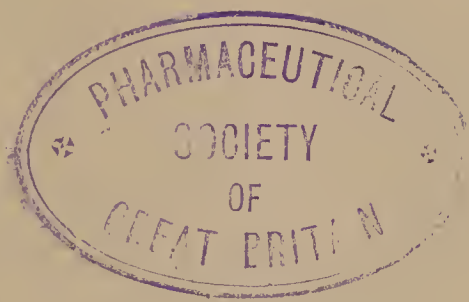
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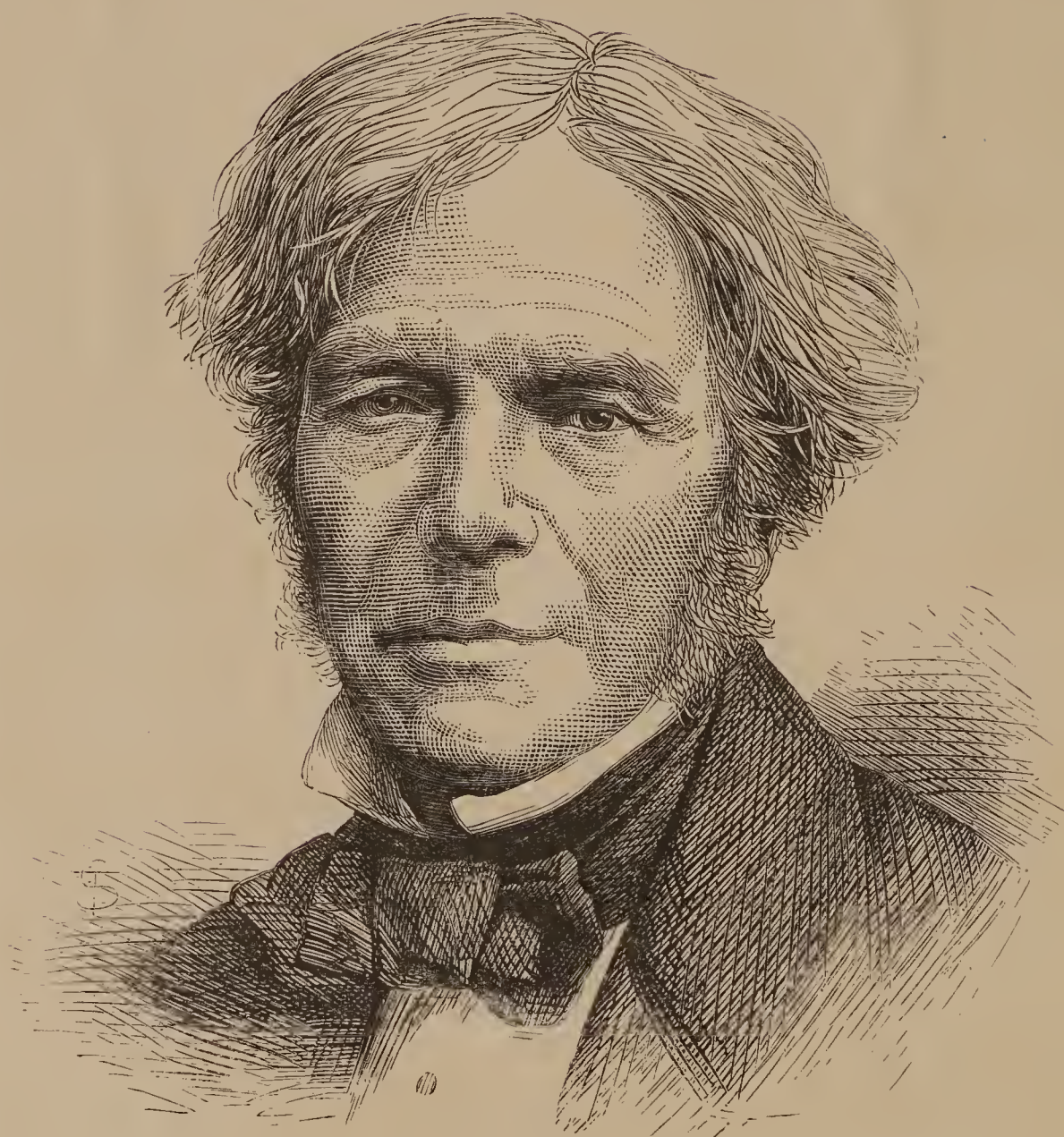
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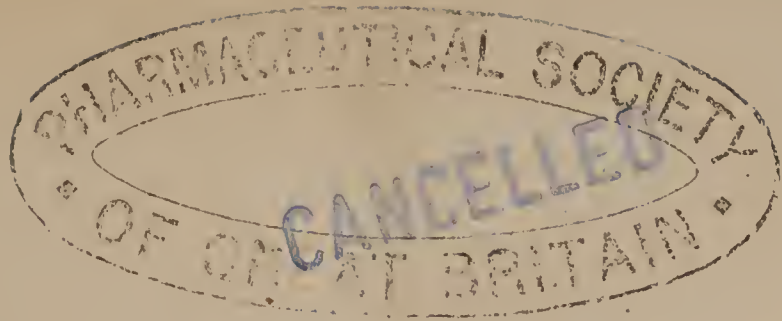






Very Truly Yours

Mr Faraday



THE
CHEMICAL NEWS

AND
JOURNAL OF PHYSICAL SCIENCE.

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO
PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY
WILLIAM CROOKES, F.R.S., &c.

VOLUME XIX.—1869.

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CHEMICAL NEWS

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PHARMACY, ARTS, AND MANUFACTURES.

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P R E F A C E.

THIS volume terminates with the five hundredth number of the "CHEMICAL NEWS," and we may, perhaps, at this juncture, not unfitly say a word or two concerning our enterprise.

The reader cannot fail to have observed that we have recently made several important improvements in the "CHEMICAL NEWS." We have striven to make it not only a chemical newspaper, but a STANDARD WORK OF REFERENCE. Besides the original and critical papers proper to a journal, we are now giving, under the head of "Chemical Notices from Foreign Sources," the titles of all the contemporary chemical papers published throughout the world, and abstracts of the more important of them. Moreover, the Index has been very carefully compiled, and made much more copious and available for ready reference. We may fairly state that the two half-yearly volumes of the "CHEMICAL NEWS" represent essentially, in extent of material and facility of reference, the *Jahresberichte der Chemie*; and, in fact, we may claim for the "CHEMICAL NEWS" that its annual issue is a handy Year-book of Chemical Science.

It is a matter of gratification to the Editor to find that the "CHEMICAL NEWS" has attained so large a circulation in America. There it is re-printed in monthly numbers, to which is added a supplement to chronicle any scientific matters pertaining specially to America. Our circulation, including that of the American reprint, has risen to about 10,000 copies of each issue. This fact we are constrained to note, since, in the majority of instances, the only rewards the man of science can ever secure are the appreciation of his labours by fellow-workers and the consciousness of having served mankind.

For more than a quarter of a century the "CHEMICAL NEWS" (with its predecessor, the *Chemical Gazette*), has faithfully recorded the progress of Chemistry and cognate sciences at home and abroad; so, in the future, our constant anxiety will be exercised to render it a still worthier representative of Chemical Science.

THE CHEMICAL NEWS.

VOLUME XIX.

EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 474.—FRIDAY, JANUARY 1, 1869.

ACCURACY.

ACCURACY and knowledge of detail are the great aims of modern scientific men. There may be much that is indefinite, but, when accuracy comes, every opposing speculation and supposed law or fact falls as hopelessly before it as that celebrated road to the skies which was felled to the earth by a well-aimed blow from Jack's hatchet. Speculation in its early meaning is seldom heard. Thought must stand on scientific ground and follow a scientific line; if it is diverted it must be at angles which accord with the logic of nature.

We sometimes like before looking at our own age to glance at that which is past. It is pleasant to associate ourselves with our brethren, however far separated. If we wish to know the history of our own thoughts we trace them back in our minds, and if we wish to know how the world learned to think we must look to the ages which preceded the building of our ideas. There is, however, another reason not so purely logical, but perhaps more powerful. There is a richness in these early thoughts because they have a tint of the eastern sun which never fades, and we shall admire their brightness whilst time lasts, or until that day when the poet comes who shall exhaust in his writings the delight which children have in the fields and the sunshine.

In early days of the world thoughts were not enchained by experiments, and great wide souls made boundless systems which endeavoured to include the infinite magnitudes that presented themselves to view in time and space. The warm colours were obtained from the fire in which they were smelted, although the heat itself has been quenched with an unheard hiss in the western seas. If we admire order, here is an idea stately and great; perhaps the formality, and, if we may add also, the imperial dignity, are among the early modes of seeking logical order and extreme accuracy. The Desatir is said to mention a system of the heavens in which each star reigns for a thousand years, and has besides one star for a prime minister; and when every heavenly body shall have gone through the two offices of minister and ruler one great heavenly period shall have been accomplished. Every year is made of days, which days again consist of one revolution of Saturn or nearly thirty years. Every year, therefore, was above 10,000 of our years. Precision in form was taken for accuracy. On this point it is to be feared that even chemists may err. Part of the above shows a desire to comprehend the infinite, and we do somewhat the same when we think of the most probable—if not well proved—central kosmic sun round which our own system revolves.

The classical ancients seemed to seek accuracy by a very different method, and, unable to comprehend the

infinite any more than their eastern forefathers, they determined at least to throw away the indefinite or vague, and this they did by making the sayings and doings of the celestials as trivial and useless as their own. The reasoning faculty has little reverence, and when it cannot grasp the wonderful it throws it aside, for the same reason as the hard uncle left the babes in the wood.

The north, like the east, had no desire to diminish the wonderful, but, perhaps, when they talked of the lights of heaven being pursued by a wolf who would swallow up the moon, they meant no more by that great capacious throat than our own stern Carlyle means when he uses such an expression as "infinite abyss." They must, however, bear the blame of inaccuracy of words. The Greek mind reduces all wild solemnities to the most unromantic common place, and thereby brings us out of much folly into plain common sense. Hear the complaint of the moon in the second century. "My patience is worn out by the philosophers who are perpetually disputing about me—who I am, of what size, how it happens that I am sometimes round and sometimes full, at other times cut in half; some say I am inhabited, others that I am only a looking glass hanging over the sea, and every one seems to fit on me any notion they may have. They even say that my light is another's and stolen from the sun, not hesitating to set me and my brother in opposition. For it is not right that they should call the sun a stone or a red-hot clump." It was centuries before this that the sun had been called a red-hot stone as large as the Peloponnesus. We in our time cannot differ far in principle from this view, and it has taken very long indeed to make steps in accuracy regarding the constitution of the heavenly bodies; still we tend to it. It would seem as if the world had always a large amount of matter standing for facts. We take pleasure in looking at an old chemical work, "*Dictionnaire de Chimie*," of the "*Encyclopédie Méthodique*," begun in 1786 on such a scale that the first volume, quarto and double columned, and of 773 pages, goes only the length of the word "Airelle." Then knowledge was actually as bulky as now, although, perhaps, no sentence is written with accuracy. They had enough to say to fill their minds;—nay, we may go very much farther back, and for mere curiosity let us quite at random take up Pliny, who knew everything of his time in a rough way, and let us ask the cure for any common pain—say headache—we are not disappointed. The remedies are abundant. The heads of slugs or wool grease, or the bones of a vulture's head, or its brains mixed with oil and cedar rosin and applied to the head and nostrils; more are given equally promising, and some pretending to great accuracy, such as "the small bone from the head of a snail that has been found between two cart ruts, and after being passed through a gold ring with a piece of ivory, is attached to the patient in a piece of dog's skin, a remedy well known to most persons, and always used with success."

The whole course of thought is now changed among men who have received even a tinge of science, but the spirit of old times is not quite forgotten. There must be many men who remember in early days that it was enough to bring forward a good quotation when they wanted a proof, and there must be many who know minds incapable of seeking any other proof. There are in Europe superstitions exactly of the kind mentioned, some of them blended with forgotten knowledge, some wholly fantastic; it is the business of science to remove them and bring more accuracy. Modern astronomy is built on a basis of very careful observation and calculation, but we have never been able to find that modern astrology had even a semblance of a basis. It is even far behind the ancient in its attempts at proof. It seeks none, whereas in the East it is said that star watchers sat carefully observing the heavens whilst others gave notice of the birth of a child, in order to know exactly at what aspect of the skies it came into the world. This would produce a science founded on fact, or it would put an end to the whole. Without a trace of experiment, men wealthy enough to promise large sums come even now to astronomers to know the course of future events, but they will not give the money to a good tutor to relieve them of their ignorance.

It is difficult to measure the distance between this merchant consulting the astronomer, and the astronomer himself, who has a difficulty in making his visitor understand that he cannot read the future. Let us say the difference is two thousand years. Let us also pause a moment to consider the progress made by the astronomer in two thousand years. Perhaps the first man that counted by seconds was one who found the pendulum to be his own heart—a heart quietly beating after the violence of youth was over, sixty times a minute. The period of one beat has become for mankind a symbol of shortness; it is a length of time passing too rapidly to be calmly surveyed, and to speak of the movements in the sky to such accuracy was not to be thought of. There was no mode of measurement. Now the ear itself has become critical beyond the heart, and it dares to measure to one-tenth, whilst the intellect, with a refinement beyond its own full comprehension, divides the same period into a million, and the strange laws of nature placidly permit that mechanism shall be formed for the purpose. The man of the dark past, although he is living now amongst us, may have heard that from the great distances in space we see in stars that which has existed many years ago, and may think that we have only to turn the telescope and, by looking the other way, see equally far into the future. We have sympathy even with him, and we too would like to know the future of chemistry and even of man.

But we are among chemists and not astronomers, although when we look far back chemistry offers us few illustrations. Since we first took up a piece of earth and said to ourselves "of what is this made?" we have a long line of men, each striving to be more accurate than his neighbour. We do often wish that we could take up a history of these later men, written not merely in English but by Englishmen who had read and weighed everything for themselves. For our facts we must go either to the originals or to the Germans. We find in these rich volumes by Kopp abundance of matter well weighed, perhaps with as much justice to Englishmen as they could do themselves, but we should like to see it written with a warm heart towards our fellows, seeking out every corner as justice alone cannot, but as kindness only can. We turn to France and there we find a history truly original also, but with a name that sounds surely German—it is Hoefer. Well, we cannot blame them: we are thankful.

We cannot see the tendency towards exactness and clearness better than by taking a chemist's view. Air was once the soul of the world, it was the life of man, it was a spirit including intellect, it was a ghost, it was capable of turning into water, which again became earth, and it was in itself nothing material, and had no weight or substance.

Now it has fallen into the ranks of ordinary things, although not less wonderful. It has been divided into parts, although unseen. This very spirit of the world has been dissected, and chemists treat it without reverence, measuring it out in tubes or weighing it on balances. Now we can scarcely tell how various its composition. It has two principal parts, but a third was soon added, whilst a fourth, under the name of ozone, has been followed by the scent for many years—we may even say since those ancient days when the smell was observed after violent lightning. Now we have plants and animal diseases almost endless, and strange influences accompanying every wind. These by degrees the scientific enquirer is hunting down, and preparing for the world new museums in nature where we shall see, by the aid of magic eyes, forms of disease lurking around and capable of being successfully attacked instead of insidiously entering and finding no one to struggle against them. The air has been, and will long be a study worthy of the greatest and the most acute, but the progress made is a great triumph, and shows that scientific men in many departments are reasoning, on the whole, rightly and fairly, gaining a victory over the world.

We may say that all organic matter comes from the air, the trees, and the lower animals, and man himself; and when we have viewed this proof which chemistry has made we almost return to the original idea that the air is the life of the world, not by general and vague reasons but by careful analyses. Out of air we may form or see formed by natural means thousands of bodies, each varied in its structure as we can prove, although air itself is invisible; and out of it will come many thousands more—movements of unseen bodies, directed by unseen forces, and observed by unseen minds. It is to this that we have come by accuracy to a world that was as unknown as if it were in Saturn, whereas we are in its midst and the scales of our eyes only want removal to shew us the irresistible intelligences at work.

The wide and hasty flights of thought are past in many departments. The workers must walk softly. Our trail is not the broad foot of the elephant on the mud, but the slightly displaced leaf of the forest. With patience the chemist watches the drops from his filter and walks up and down on guard; with patience he observes that one-thousandth of the weight has been lost and that he ought to have lost less; he begins again. We do not wonder at Professor Rose being excited when a courtier walking about in his laboratory touched with exquisite forefinger a transparent precipitate of alumina on a filter. Stateliness of manners was forgotten. The chemist seized the offending finger and never ceased to wash it with a jet of water till the earth was all returned to the funnel; nor could he venture to explain, since the jet was driven by his own mouth and swollen cheeks.

The idea of cleanliness in all its accuracy is known only to chemists. When preparing a substance for analysis is there any trouble that we avoid if we can aid success. What! in a vile laboratory? Yes; no foul air must touch these bodies. Air, that which the most sensitive persons would consider sweet, would be poison. The slightest trace of carbonic acid or moisture, things found in all breezes, would make some analyses imperfect. We can well remember when in that stage of learning when sulphur and hydrogen are so much employed for metals we rushed forward to seek advice, but were driven back from the sanctum by the usually most urbane and pleasant friend. What could that mean? he was preparing a silver salt in order to obtain an important atomic weight. We are obliged to use not only pure air, but sometimes artificial atmospheres, and sometimes the entire absence of atmosphere. As to analysis generally, most chemists have seen in their own day the rise of the methods of Fresenius. It was no easy matter to learn from that of Rose. The information was great, but the system deficient. Now the details and system of Fresenius seem to form an embodiment of logic itself, and if any one learns them he must have learned to reason in such a way that he will

gain a great superiority over his former self. Every step carelessly made shews itself in material mistakes; the student must reason closely to keep his solutions correct. He cannot go with mere enthusiasm and boasting long. His own results bring him the greatest reproaches, his experiments silently humble him, and he is laughed at by forces that he cannot avenge.

We see the value of accurate work in Berzelius perhaps more than in any man. He built up inorganic chemistry, and if any man follows his work in organic departments he will learn to wonder at its accuracy. He worked as if the eyes of posterity were on all his movements, and he seemed to be able to do his enormous labours by making few blunders. There is no chemist from whom the young can learn so much of the art of working long and honestly. We modify his structure, but it was said by one, himself a great man, "Berzelius is the greatest chemist that is, or that was, or that will be."

We remember sitting with an old philosopher, when he said "Would you like to see the atoms of Epicurus, out of which the worlds were made—true star-dust?" Who would have said no? he brought a little bottle of meteoric dust—but we must not describe it; he will do it, or has done it. We thought of these atoms now visible to a microscope but still divided by the chemist in many portions, and long after the finest microscope can aid the finest eye the chemist goes on dividing, and with a certainty which is absolute.

It was our wish to shew that science is gradually making its devotees the representatives of care and accuracy. We have scarcely space to carry out the plan fully, but chemists are accustomed to such a variety of occupations that they can readily finish this article for themselves. It is a fine quality that of uttering undeniable truth. Let us not lower that position but rather magnify our office. Let our words suit the facts with an accuracy equal to that with which the facts themselves can be ascertained, and in a world of wavering and changing let us show that there is a class of facts to be found upon which reliance can be placed so far that we may be certain they will never change. In common affairs a mistake may have but a short life, but in the study of nature an imperfect observation may cause infinite trouble to thousands. The increased study of science will promote exact observation and greater love of truth among men, and will produce a race that will either absorb the worthless residuum or drive it hence into the unknown and unseen.

ON A MODIFICATION OF THE METHOD OF ASSAYING SILVER COMPOUNDS IN THE WET WAY.

By M. STAS.

The mode of testing in the wet way in order to fix the standard of silver substances, as established by Gay-Lussac, is open, under certain conditions, to a source of error, arising from the solubility of chloride of silver in the very liquid to which its origin is due. This solution, whatever its mode of production may be, is precipitated equally by a decimal solution of silver and by chlorhydric acid. The extent to which this precipitation ensues is uncertain. At the ordinary temperature, there may be a variation of from one to six thousandths in 100 c.c. of the liquid. Practically, it is quite possible, while still preserving the simplicity of the wet method, as invented by Gay-Lussac, to substitute a bromide for a chloride in precipitating silver, and thus remove absolutely those anomalies which have been observed to be attendant upon the use of a chloride or of chlorhydric acid.—*Comptes Rendus*.

ON THE ESTIMATION OF TITANIC ACID.

By DAVID FORBES, F.R.S., &c.

THE results of numerous analyses of rocks and of the products arising from their disintegration and decomposition have proved thoroughly confirmatory of the observations by Mr. Riley brought forward in his valuable paper "On the General Occurrence of Titanic Acid in Clays, &c.," published in vol. xv. of *The Journal of the Chemical Society*; and having myself, in the course of these investigations, paid considerable attention to the various processes employed for determining the presence and amount of titanic acid contained in mineral and metallurgical products, it is considered that the following remarks upon this subject may probably be of use to the analyst:—

As it still appears to be the common opinion, that, in the process of the analysis of mineral silicates, titanic acid when present does remain altogether, or in greatest part behind along with the silica which has been separated from the bases, it seemed, therefore, desirable to ascertain how far this actually was the case, and also whether any definite ratio existed between the amount of the insoluble titanic acid which remained behind with the silica and that which was taken up by the acid solution.

The result of the examination of several clays and rocks containing this acid, served to show that a very considerable amount of the entire titanic acid present in the substance analysed, did really enter into solution, and consequently that a material error would occur in the statement of the results of the analysis, if this amount was neglected, and merely the quantity remaining behind with the silica was assumed to represent the total percentage of titanic acid present in the substance under examination.

A single example will suffice to show that this is actually the case. Upon analysis, at the request of Mr. George Maw, F.G.S.,* of a red clay, which formed a stratum of from 7 to 8 feet in thickness, occurring at about the middle of the Shropshire coal measures at Calcotts, near Broseley, the following percentage composition was found:—

Silica, combined	29.71	} 64.06
„ free	34.35	
Titanic acid, insoluble	0.37	} 0.62
„ soluble	0.25	
Alumina	20.60	
Sesquioxide of iron	6.84	
Protoxide of iron	0.32	
Protoxide of manganese	0.09	
Lime	0.12	
Magnesia	0.04	
Potash	0.91	
Soda	0.44	
Water, with traces of organic matter	5.85	
		99.89

From these results it will be seen that above 40 per cent of the entire amount of titanic acid present in the clay had entered into solution, and was afterwards thrown down by ammonia (which precipitates titanic acid completely) along with the alumina and sesquioxide of iron obtained together in the course of the analysis.

The method employed in separating the titanic acid from these substances, was simply to dissolve the precipitate of alumina, sesquioxide of iron, and titanic acid in dilute sulphuric acid, to neutralise a considerable portion of the excess of sulphuric acid by solution of caustic soda, then to add a few drops of nitric acid, which prevents the titanic acid subsequently precipitated, from carrying

* *Vide Quarterly Journal of the Geological Society*, vol. xxiv., p. 354, 1868.

down with it more than a trace of sesquioxide of iron, and after still further dilution with a large excess of water, to boil for some time until all the titanitic acid is precipitated in the insoluble form.

The insoluble titanitic acid remaining with the silica was extracted from it, by boiling the silica in a platinum crucible for some time, with concentrated pure sulphuric acid, allowing it to cool, and then pouring the whole rapidly into a large excess of cold water so as to avoid any considerable rise in temperature of the solution; after filtration from the insoluble silica, the solution was nearly neutralised by soda, a little nitric acid added, and the titanitic acid precipitated by boiling as before.

According to Marignac, titanitic acid is precipitated from its solution in concentrated sulphuric acid after dilution with from five to six times its volume of water upon boiling, but it was found safest to neutralise a large portion of the excess of the acid by soda before boiling the solution, which, after filtration, was, upon subsequent testing, not found to retain any appreciable amount of titanitic acid.

The results of various experiments, not only proved that the proportion of titanitic acid dissolved, amounted to a very large percentage of the total titanitic acid contained in the silicate, but also showed, especially when but very little titanitic acid was present in the mineral or rock, that the amount which entered into solution might occasionally be much greater than that which remained behind with the silica. In all analyses, therefore, it becomes a matter of necessity to determine both the soluble as well as the insoluble titanitic acid, in order to obtain correct results both as regards the amount of titanitic acid present or also to obtain the true percentage of the silica, alumina, and sesquioxide of iron. Even when the total amount of titanitic acid in a mineral has been determined by the usual process of fusing it with from eight to sixteen times its weight of bisulphate of potash, or, still better, bisulphate of soda (since the soda compounds are much more soluble), and afterwards boiling the very dilute solution of the fused mass in cold water, until all titanitic acid is precipitated; there still remains the difficulty of knowing how much of the titanitic acid thus found should be deducted respectively from the weight of the silica or from that of the mixed precipitates of alumina with sesquioxide of iron.

In these cases I have found the following mode of procedure convenient:—The mineral, clay, or rock reduced to an impalpable powder, is placed in a proper sized platinum crucible, and made into a very liquid paste with pure concentrated sulphuric acid; the whole is then kept for some hours exposed to a temperature sufficiently high to cause it to emit slight fumes of sulphuric acid without making it boil or spirt. By this means the entire amount of titanitic acid present, combined or uncombined in the substance, appears to be converted into the soluble modification and is taken up by the sulphuric acid.

The whole is now allowed to become quite cold, the contents of the crucible is then discharged into a beaker glass containing so large an excess of cold water that no rise of temperature need be apprehended, and the crucible itself washed out with cold water. This solution is now filtered from the insoluble matter, consisting of silica along with any undecomposed silicate which may remain unacted upon by the sulphuric (and if much lime, strontia, or barytes, is present, some sulphates of these earths) acid; this should be washed, first with cold and then with hot water. The filtrate is now nearly neutralised by caustic soda and boiled for a considerable time, occasionally adding more water as evaporation takes place, so as always to keep the solution very dilute, until all the titanitic acid has been precipitated.

Should much iron be contained in the solution, a little nitric acid should be added to the filtrate previous to boiling, in order to prevent the titanitic acid carrying down with it more than a trace of sesquioxide of iron.

The titanitic acid thus obtained usually retains some sulphuric acid, and should be heated with the addition

of a little carbonate of ammonia to volatilise this acid; after ignition the titanitic acid usually is of a light yellow colour, but should it present a deep red appearance, due to sesquioxide of iron carried down along with it, it should be fused with bisulphate of potash or soda, the fused mass dissolved in an excess of cold water, a few drops of nitric acid added, and the solution boiled, when it will be obtained nearly colourless or of a faint yellow tinge.

The insoluble matter obtained after treatment of the original substance may now be fused with carbonate of soda and potash as usual in the analysis of an insoluble silicate, taking care, of course, to add to its solution the filtrate from which the titanitic acid has been precipitated by boiling.

In some cases, where but traces of lime or other element which would form a sulphate insoluble in water or solution of sulphate of soda or potash are present (zirconia thorina, &c.), the analysis may be made by fusing the mineral with about ten times its weight of bisulphate of soda or potash, (preferably the former, from the easy solubility of its fused product) dissolving the mass in cold water and filtering it from the insoluble silica, which, after washing, first with cold and then with hot water, may be weighed after ignition as usual. From the filtrate the titanitic acid is precipitated by boiling, some nitric acid having previously been added in case oxide of iron is present in any quantity, and after filtration the solution can be used for determining the bases, alumina, iron, magnesia, &c., as usual.

In estimating the amount of titanium or titanitic acid in samples of cast or wrought-iron this substance has usually been sought for in the residue insoluble in acids, but the following experiments also prove that such a procedure cannot be relied upon as furnishing correct results.

A sample of cast-iron produced from smelting a titaniferous magnetite from Gullaxrud, in Norway, in a charcoal blast furnace, the complete analysis of which ore is given in the CHEMICAL NEWS, vol. xviii., No. 471, p. 276, was taken, and 251.59 grains in small fragments dissolved in nitrohydrochloric acid; the insoluble residue was collected on a filter, incinerated, digested with sulphuric acid, and the titanitic acid present determined as before described, when it was found to amount to 0.52 grains, equivalent to 0.207 per cent titanitic acid or 0.126 per cent titanium.

The filtrate was now neutralised carefully with ammonia, and then a slight excess of ammonia added, so as to cause a small permanent precipitate of sesquioxide of iron to be formed, which was then filtered off from the ferruginous solution and washed. This precipitate, which contained all the titanitic and phosphoric acid present in the iron, along with an excess of sesquioxide of iron, was now dissolved in a little very dilute sulphuric acid, some nitric acid added and the solution boiled; an immediate precipitate of titanitic acid was formed which, when determined, amounted to 0.14 grains, or 0.056 per cent, equivalent to 0.034 per cent titanium. The examination of this cast-iron resulted in showing that it contained 0.207 per cent titanitic acid in the insoluble form, and 0.056 per cent titanitic acid in the soluble form, or a total of 0.263 per cent titanitic acid, and that, consequently, more than 20 per cent of the entire titanitic acid had been dissolved of the acids employed in the analysis.

Another sample of cast-iron produced from smelting the titaniferous magnetite from Christine Mine, near Krageroe, in Norway, was also examined with the same object in view. In this case 104.26 grains of the cast-iron in fragments were dissolved in nitrohydrochloric acid, and left an insoluble residue which, after incineration, weighed 2.47 grains; this was, as in the last case, digested in concentrated sulphuric acid; the titanitic acid, which was determined as before described, weighed only 0.02 grains. The acid filtrate was then treated with ammonia, so as to precipitate a small amount of the sesquioxide of iron along with

any titanitic acid contained in the iron, and this latter determined as in the former case, amounted to 0.03 grain.

The result of this experiment shows, therefore, that this cast-iron contained a total of only 0.048 per cent titanitic acid (equivalent to 0.029 titanium) of which 0.019 per cent remained in the insoluble residue, whilst 0.029 per cent had been dissolved in the acid solution, confirming the previously arrived at conclusion, that when a very small amount of titanitic acid is present in a substance, the major part of it is often, if not always, to be found in the solution, and not in the insoluble residue.

I have not been able, as yet (although I have made several experiments for the purpose), to prove satisfactorily that titanium alloys with iron, but the analysis of various samples of cast-iron, wrought, bar, and steel smelted from ores containing titanitic acid in considerable quantity, appear rather to indicate that the small amount of titanium which they really do contain, is mechanically associated with the iron probably in an oxidised state, than present as a true alloy with the iron itself.

ON THE IMMEDIATE ANALYSIS OF METEORIC IRONS.*

By STANISLAS MEUNIER,
Aide Naturaliste at the Museum of Paris.

THE numerous researches hitherto made with regard to the composition of meteoric irons have demonstrated in these extra-terrestrial bodies the existence of the following compounds:—

1. The *general mass* which is formed by the union of several alloys in which iron and nickel are predominant, and which we will designate under the name of *nickeliferous iron*. Among the substances comprised in this mass, the *kamacite*, the *tænite*, and the *plessite* will be specially mentioned.
2. The *carburetted iron* comprising the *Campbellite*, and the *Chalypite*, recognisable by the carboniferous deposit which they give under the action of acids.
3. The *sulphuretted iron*, or *troïlite*, which appears in nodules and in veins.
4. The *phosphide of iron and nickel*, or *Schreibersite*.
5. The *graphite*.
6. The *external crust*.
7. The *stony particles*, or *crystals*.
8. The *gases* retained by occlusion (Graham).
9. Several compounds which are only met with exceptionally, as *chromite* and *protochloride of iron*.

The last may even have a terrestrial origin, according to the opinion of Mr. Shepard.

I have recently tried to separate those different substances, and I have submitted each of them to a special examination. My results are, for the greatest number, the fixation of their chemical formulæ, and I think they will be received with interest.

I. NICKELIFEROUS IRON.

The first problem to be solved is the separation of the different alloys which are mixed in the general mass of meteoric irons; but it is necessary first of all to prepare that general mass freed from other substances which I have already named.

For this end, the iron being reduced to powder by means of a hard file, the metal is thrown into pure potash fused in a silver crucible. Instantaneously the alkali, hitherto limpid, becomes troubled by the presence of little grey flakes, which are the result of decomposition of troïlite, schreibersite, stony matters, &c., and consist of oxide of iron.

When this decomposition of foreign substances is com-

plete, the alkaline mass is cooled and treated by water. All the potash is carried away with the greatest part of oxide of iron. The remainder of this oxide is easily dissolved by strong nitric acid, in which the iron becomes passive.

The metallic powder is then well washed and dried; it is exclusively formed of nickeliferous iron, containing, however, in certain cases, a small proportion of carburetted iron.

Chemical methods have not yet completely succeeded in separating the alloys mixed in the nickeliferous iron, and, after several essays, I have been obliged to employ a physical process.

My experiments have been made with the meteoric irons of Caille (France), and of Charcas (Mexico).

First of all, it was necessary to determine with exactness the number of constituent compounds contained in the nickeliferous iron of those masses. For that purpose a small polished plate of the iron of Caille was heated with precaution and uniformity. This operation, of which the first idea is due to Widmanstættén, drew, by the unequal oxidability of the different *immediate principles*, a yellow net upon a blue ground. There were also several portions of an intermediate colour, clearly limited like the others, and occupying the spaces bounded by the crossing of the yellow lines.

An attentive examination showed that the three metals were reduced to two; the third being formed by the mixture of the others, reduced to alternate thin sheets.

The blue iron is formed by the *kamacite*, and the yellow by the *tænite*.

Their separation was very difficult on account of the analogy of the chemical properties of the two metals. If it is true that the *kamacite* is more soluble than the *tænite* (and this is proved by the experiment of Widmanstættén), it is true also that the difference is too small to permit a separation. When all the *kamacite* is dissolved, only a very small proportion of the *tænite* remains; the greatest part being dissolved also.

To effect the separation, I heated some metallic powder placed upon a glass plate. The particles formed by *kamacite* become blue, whilst the particles of *tænite* are yellow. Then the two sorts of grains are separated with a pincer.

After about fifteen operations, I collected 2 grammes of *kamacite*, and 0.5 grammes of *tænite*, that I could chemically examine.

The Charcas iron gives the same results.

The specific weight of *tænite* is 7.380. Its analysis has given me the following numbers:—

Iron	85.0
Nickel	14.0
	99.0

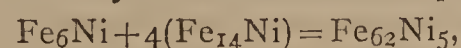
which agree with the formula Fe_6Ni .

The *kamacite* has a specific weight equal to 7.652, and I have found for its composition—

Iron	91.9
Nickel	7.0
	98.9

Its formula is Fe_{14}Ni .

On this subject it will be remarked that in admitting, according to the numbers given above, that the Caille iron contains 80 per cent of *kamacite* and 20 per cent of *tænite*, its elementary formula will be expressed by



which gives numbers very near those which M. Rivot has obtained in the elementary analysis of that mass.

The above formula gives—

Iron	91.4
Nickel	8.6
	100.0

And M. Rivot has found, in two analyses—

Iron	..	..	..	92.3	..	..	92.7
Nickel	..	..	..	6.3	..	..	5.6
				98.6	98.3		

All meteoric irons are not so simple as those of Caille and of Charcas. There are some which contain with kamacite and tænite a certain quantity of other metallic alloys.

One of the most important of these is the plessite, which abounds, for example, in irons of Jewell Hill (North Carolina), and of Oldham (Kentucky). I have isolated it by the same method which had served for the preceding substances.

The plessite offers a density of 7.850, and I think that its composition is well represented by the formula Fe_{10}Ni , but I have had so little of this substance that I cannot make a completely satisfactory analysis.

Amongst the other alloys of iron and nickel, I will name the *octibbehite*, whose composition is exceedingly remarkable for the large proportion of nickel (59.60 per cent). Its density is only equal to 6.854. The meteoric iron of Octibbeha (Mississippi) seems to be entirely formed of that alloy; this results from the studies of Mr. Taylor.

II. CARBURETTED IRON.

Several meteoric irons give, by the action of acid, a black deposit, more or less abundant, consisting of carbon. This carbon comes from a compound of which the composition is analogous to that of steel.

In this point of view, the meteoric iron of Campbell (Tennessee) will be specially mentioned. It gives by analysis a metallic matter, formed by the union of 1.50 per cent of carbon with 97.54 per cent of iron. I propose for it the name of *Campbellite*; its density is 7.05.

Mr. Shepard gives the name of *chalybite* to a carbide of iron which Forchhammer has noticed the presence in the meteoric iron of Niakornak (Greenland), and of which the formula is CFe_2 . I have had no opportunity of seeing this substance, which does not exist in the Museum of Paris.

III. SULPHURETTED IRON.

To prepare the sulphuretted iron, or *troïlite*, in a complete state of purity, we may have recourse to the metallic powder. This powder is placed during a quarter of an hour in a boiling concentrated solution of sulphate of copper. All the nickeliferous iron is dissolved, and, by decanting and washing, a mixture of metallic copper, troïlite, schreibersite, graphite, and stony matter is obtained.

A small quantity of concentrated nitric acid dissolves the copper. The magnet, acting under water, is the best means to separate troïlite and schreibersite (which are magnetic) from graphite and stony matter. Lixiviation, in conclusion, can be employed to isolate troïlite from schreibersite.

When the iron under experiment contains only a small quantity of troïlite, it is preferable not to make use of nitric acid, which always dissolves a little of the desired substance. In these cases I dissolve the nickeliferous iron by means of bichloride of mercury. The protochloride of mercury is carried off by a solution of chlorine, and it is easy to separate the metallic mercury.

Besides, it is always better, when possible, not to extract troïlite, from no matter what part of iron, but from the cylindroid nodules in which the substance has concentrated itself. Thus the sulphuretted iron contains only some graphite and stony matter, which can be got rid of by the action of the magnet. It is correct to say that this troïlite is one of the most characteristic principles of meteoric iron. Notwithstanding, its crystalline forms have not yet been recognised, and there is some doubt about its chemical composition.

The first chemists who examined it considered it as a variety of Breithaupt's pyrrhotine, and gave to it the formula Fe_7S_8 .

But Mr. Lawrence Smith concluded from his analysis of the sulphur of the iron of Tazewell, that it has the composition of a protosulphide FeS .

Notwithstanding, he continued to give it the name of pyrrhotine, and thus a great confusion was introduced into science. Besides, Mr. Smith rested both upon the results of his own experiments and upon those obtained by several chemists in the examination of other troïlites, his conclusion was not admitted, and the existence of true crystalline magnetic pyrites, in meteorites will increase the doubts.

The distinction between the troïlite (or Mr. Smith's pyrrhotine) and the Breithaupt's pyrrhotine, is not so clear as it seems at the first view. The difference of composition is very slight, and the physical properties are very similar.

I have had lately occasion to analyse several specimens of troïlite taken from the meteoric irons of Charcas and of Toluca (Mexico), and the numbers which I have obtained have given me reason to think that the mineral in question is nearer to magnetic pyrites than to protosulphide of iron.

Before giving the results of my analyses, I will call attention to a reaction which seems to me calculated to permit in all cases to distinguish the protosulphide from the magnetic pyrites, and, *à fortiori*, from compounds which are more rich in sulphur.

When protosulphide of iron is placed in a solution of copper, it precipitates this metal almost like iron itself; pyrrhotine, on the contrary, does not produce such a precipitation. The protosulphide obtained by the action of sulphide of ammonium upon iron salts produced the same effect as the substance of exactly the same composition prepared by igneous means.

This being well established, I put several troïlites into a solution of copper, and I did not observe any precipitation; the troïlite is then very like the magnetic pyrites in this respect, and we may arrive at the same conclusion relatively to the chemical composition.

In fact Mr. Smith has based his formula, FeS , upon his analysis of Tazewell's troïlite, which gave him:—

Iron	..	..	..	..	..	..	62.38
Nickel	..	..	..	..	..	..	0.62
Copper	..	..	..	..	..	..	trace
Lime	..	..	..	..	..	..	0.08
Silica	..	..	..	..	..	..	0.56
Sulphur	..	..	..	..	..	..	35.67
				99.31			

But these numbers show that the substance employed in his experiments was very impure.

I have begun to purify the troïlite by the process described above, and I have thus obtained a matter of which the specific gravity was 4.799. Its colour was bronze, and its analysis gave me:—

Iron	..	..	..	..	..	..	59.01
Nickel	..	..	..	..	..	..	0.14
Copper	..	..	..	..	..	..	trace
Sulphur	..	..	..	..	..	..	40.03
				99.18			

I will remind the reader that the formula Fe_7S_8 requires—

Iron	..	..	..	..	..	..	60.4
Sulphur	..	..	..	..	..	..	39.6
				100.00			

The Charcas troïlite, previously purified, gave me—

Iron	56.29
Nickel	3.10
Sulphur	39.21
	<hr/>
	98.60

Its density is equal to 4.78.

The normal presence of nickel makes of troïlite a species distinct from pyrrhotine, and its true formula is $(\text{Fe.Ni})_7\text{S}_8$.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 17, 1868.

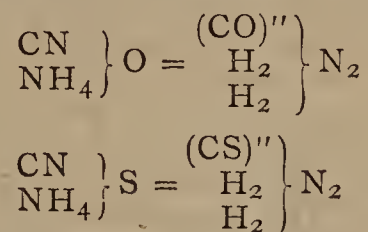
Dr. WARREN DE LA RUE, F.R.S., President, in the chair.

THE minutes of the previous meeting having been read and confirmed, and the usual lists of donations and of visitors having been announced, the following certificates were read.

For the first time—Mr. J. J. Field, Highgate, Mr. H. W. Kearns, Accrington, Mr. E. L. Barret, 44, Lawford Road, London. For the second time—Mr. F. W. Hart, Mr. E. K. Muspratt, Mr. S. Williams, Mr. J. F. Allen. For the third time—Mr. T. Rowan, Mr. W. W. Stoddart, Mr. J. Hughes. The three last-named gentlemen were then balloted for and were duly elected.

The SECRETARY then read a paper "*On the Isolation of the Missing Sulphur Urea*," by J. Emerson Reynolds, Member of the Royal College of Physicians, Edinburgh, Keeper of the Minerals and Analyst to the Royal Dublin Society, &c.

Just as cyanate of ammonium under the influence of heat yields urea, so sulphocyanate of ammonium under similar circumstances should yield sulphur urea—



The probability of this reaction induced Liebig, Völckel, and some other chemists to study the action of heat upon the sulphocyanate, but the results did not agree with their expectations.

More recently Dr. Hofmann* described a number of substitution derivatives of sulphur urea, but he did not succeed in isolating the urea itself. He appears to have regarded sulphocyanate of ammonium as the true sulphur urea, in spite of its saline constitution.

The author, in considering the points of similarity and of difference between the cyanate and sulphocyanate of ammonium, became convinced that the greater stability of the latter compound was the chief bar to its molecular rearrangement.

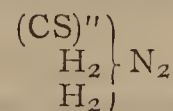
The temperature of 100° C., which effects the conversion of the cyanate into urea, has no effect upon the sulphocyanate, which, however, decomposes easily at temperatures above 180° C. The author therefore tried the effect of a regulated temperature upon the latter salt, and was rewarded by the isolation of the missing sulphur urea. He proceeded in the following manner:—

About 500 grammes of the well-dried salt were heated to 170° C. for two hours by means of an oil bath, the author remarking incidentally that the true fusing point of the

salt was found to be 159° C., instead of 147° as usually stated.

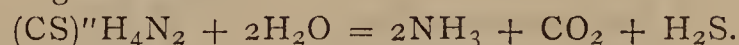
The mass was allowed to cool to 100° C., and was then treated with its own weight of water at 80° C. When the whole was dissolved, the liquid was filtered through a plug of cotton wool for the purpose of separating a small quantity of black substance, and was then allowed to stand until an abundant crop of fine long silky prisms of the new compound had formed.

After several recrystallisations from boiling water, the urea was obtained in a state of purity, and gave on analysis numbers which led to the formula—



Some difficulty was experienced in the determination of the carbon in consequence of the large proportion of nitrogen and sulphur present. It was found advantageous to introduce into the combustion tube, after filling with chromate of lead in the usual manner, a porous copper rod, prepared by rolling fine gauze so closely as to leave no central tube. This rod was heated, first in air and then in hydrogen, in the usual way, and was then made to fit closely into the combustion tube. It was found to reduce completely the nitrogen oxides formed during the combustion.

The new substance crystallises in long fine needles or in short thick prisms, in either case belonging to the trimetric system. It is non-deliquescent in moderately dry air, is very soluble in water and alcohol, and sparingly so in ether. The solution froths slightly on agitation, has a neutral reaction, and a somewhat bitter taste. Heated with water in a sealed tube for some hours to 140° C., it is reconverted into sulphocyanate of ammonium, as may be shown by the iron test. The urea does not give a colour reaction with the test. Heated with hydrate of potassium in a sealed tube, it is decomposed in the following manner:—

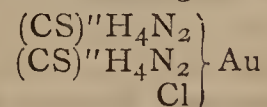


Hydrochloric and sulphuric acids effect a similar change.

The substance fuses at 156° C. Heated to a higher temperature in a closed tube it evolves sulphide of ammonium, carbonic disulphide, and ammonia; the mixture blackens, a yellow oil distils over, and a white mass remains which strongly resembles Liebig's hydromellone.

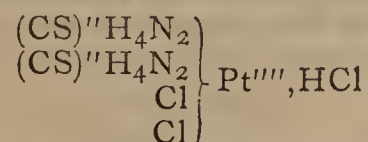
A beautifully crystallised nitrate of the new urea was prepared by treating the strong aqueous solution with nitric acid of sp. gr. 1.25. Its formula was found to be $(\text{CS})''\text{H}_2\text{N}_2, \text{HNO}_3$. No hydrochlorate nor oxalate could be obtained.

Gold Compound.—On treating a saturated aqueous solution of the urea with neutral terchloride of gold, a reddish precipitate appeared at first, which quickly redissolved, when a yellow colour appeared in the liquid; it was slowly evaporated and yielded pearly monoclinic crystals, to which the author assigns the singular formula—



When the gold solution was employed in excess a very unstable compound was produced, which appeared to differ from the former one in containing only 1 equivalent of the urea and 2 of chlorine.

Platinum Compounds.—By methods analogous to the preceding, several platinum compounds were procured. For the most characteristic of them the author obtained the following formula:—



Silver Compound.—The action of nitrate of silver on the urea yielded silky crystals having the formula—



* Proc. Roy. Soc., ix., 274.

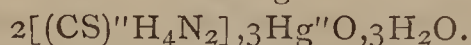
This compound is decomposed by heat with slight explosion, sulphide of silver and a crystalline sublimate being formed.

When sulphur urea and hydrate of silver are heated with a little water for half-an-hour, sulphide of silver is formed, and the urea is converted into ordinary urea—

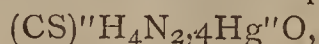


It is, therefore, probable that in the little-known process for the preparation of carbamide by the action of oxide of silver on sulphocyanate of ammonium, there are really two stages—one in which sulphur-urea is formed, and one in which it is converted into ordinary urea and sulphide of silver.

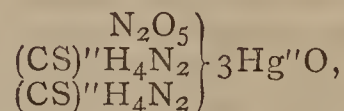
Mercurial Compounds.—A crystalline compound was obtained to which the author assigns the formula—



But it appears probable that the compound—

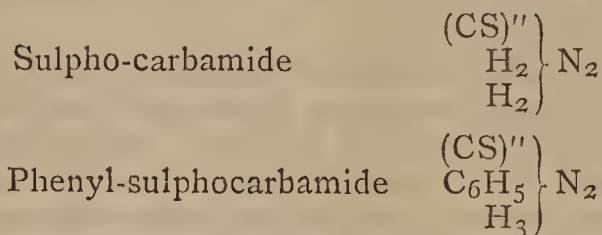


and



are likewise produced in some reactions.

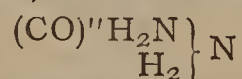
All ureas previously obtained possess more or less strongly marked basic properties, and the author believes that the new compound is the first instance known of a urea which manifests strongly marked acid and feeble basic properties. It follows from this investigation that the new compound is the true sulpho-carbamide, the primary of the series of compound sulpho-ureas discovered by Hofmann, and that sulpho-cyanate of ammonium must be regarded as the strict analogue of cyanate of ammonium. The author gives a list of Hofmann's compounds, and points out how simply they all relate themselves to sulphur urea. The following will serve by way of illustration:—



The author concludes by predicting the formation of sulphur-urea by the action of heat on sulphocarbamate of ammonium. Such a reaction would be perfectly parallel with that by which Bassaroff produced urea, namely, by the dehydration of carbamate of ammonium.

The PRESIDENT remarked upon the great beauty and simplicity of the primary reaction effected by the author.

Professor ODLING had no observations to make in direct discussion of the subject of the paper, but its close connection with urea tempted him to make a few remarks on the interesting theoretical question of the constitution of that compound. The current belief at present was that urea was identical with carbamide, and some facts were strongly in favour of this view; but, as he had pointed out some time ago, other facts were discordant, and Messrs. Wanklyn and Gamgee had lately, from experiments of their own, proposed a perfectly different formula for urea. There was a fundamental difference in the two views, and, in fact, we could not as yet say that we know the mode in which the carbon of urea was connected with the nitrogen. In addition to these two views a third had been suggested by Professor Kolbe, which, like everything that fell from his lips, was entitled to the most respectful consideration of chemists. Kolbe maintained that urea was not carbamide, but an amide of carbamic acid, and he wrote its formula thus:—

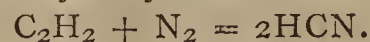


It appeared, however, to the speaker, that this was but a variation in the mode of writing the formula. He found himself unable to perceive how the amide of carbamic acid

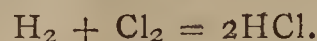
could be a different substance from carbamide. Possibly some disciple of Professor Kolbe—and most likely some were present—could point out where the difference lay.

Professor WANKLYN had nothing to add to the arguments which he, in conjunction with Mr. Gamgee, laid before the Chemical Society on a former occasion. He believed that urea was not carbamide, because he found it wanting in some of the common reactions of the amides.

As there was no further business before the Society, Sir Benjamin Brodie, whose re-appearance after a somewhat lengthened absence was cordially hailed by the President and Fellows, drew the attention of the meeting to a very remarkable paper by Berthelot, published in the last number of the *Comptes Rendus*. Berthelot had subjected a mixture of acetylene and nitrogen to the action of the electric discharge, and had thus, by a direct union of radicals, formed hydrocyanic acid—



Nearly the whole of the acetylene employed combined with nitrogen, and the reaction might be said to be strictly analogous to that in which hydrochloric acid was produced by double decomposition—



The meeting then adjourned until January 21, 1869.

FOREIGN SCIENCE.

PARIS, Dec. 30, 1868.

Kreatinine, an index of putrefaction.—The bleaching of wood pulp. ACADEMY OF SCIENCES: Behaviour of chlorides of sodium and potassium in presence of metallic vapours.—Estimation of nitrites in presence of nitrates and organic matter.—Cinnamate of benzile.

AN index of the commencement of putrefaction in many animal substances may possibly be found by the presence of kreatinine. In a note on the presence of this body in putrified whey, M. Commaille, among other interesting things, mentions the above fact. Some filtered whey was placed in a flask, simply covered with paper, and set aside for about a year. The whey fermented and then putrified; numerous microzymas made their appearance, and the liquid became coloured a deep brown. Afterwards, the animal life gave place to a thick mass of spores; the foetid odour was succeeded by a musty odour only. The liquid thus altered was filtered, evaporated on the water-bath, and treated with alcohol of 85°, which became strongly coloured. This alcoholic solution was evaporated and the residue treated with alcohol of 90°, which removed a portion; the substances obtained from the evaporation of the alcohol of 90° were divided by alcohol of 95°. That portion undissolved treated with water gave abundant crystals containing much mineral matter. Calcined, these crystals leave a white and saline ash; treated, after solution, with nitrate of silver they yield a voluminous precipitate, which cedes to boiling water a small quantity of long needles, which are perhaps nitrate of kreatinine. The portion removed by alcohol of 95° furnishes, upon evaporation of the liquid, numerous crystals, which, under the microscope, appear as rectangular plates. These crystals are soluble in water and alcohol, insoluble in ether; they react as follows:—with nitrate of silver, a white magma, soon resolved into silky needles of double nitrate of silver and kreatinine; with syrupy chloride of zinc, small masses, which, examined under the microscope, appear as fine needles in radiating groups; these crystals are double chloride of zinc and kreatinine; with recently precipitated biniodide of mercury, at ebullition, metallic mercury. The kreatinine thus obtained is far from pure. Kreatinine ($\text{C}_8\text{H}_7\text{N}_3\text{O}_2$) occurs in the putrified whey from the dehydration of the kreatine ($\text{C}_8\text{H}_9\text{N}_3\text{O}_4\text{HO}$) already present in the milk. Urine, which has been exposed to the air for some weeks, contains no longer kreatine, but only kreatinine. It would thus seem that the small quantity

of kreatinine found in beef tea and recent urine indicates an alteration, inappreciable, one may add, by other means. Kreatine is, in fact, much more often found in fresh animal substances than kreatinine. The reason that kreatine has not been found in milk is probably the great amount of other materials present with it; and only when the lactine has been destroyed by fermentation and putrefaction, it becomes easy to detect in the whey the derivative kreatinine. The detection of a substance hitherto considered excrementitious in milk is worthy of remark. A further analogy between milk, blood, and meat, is also established.

A process of bleaching wood pulp has been made known by M. Orioli. He has recognised (1) that chloride of lime however little in excess, has a tendency to produce a yellow tint; (2) that all the strong acids turn the paste red under the action of the sun, or in some time without sunlight, in the presence of moisture; (3) that the slightest trace of iron is sufficient to blacken the paste in a very short time. These objectionable results are obviated by the following mixture:—For 100 kilogrammes of wood pulp 800 grammes of oxalic are employed, this serving the double purpose of bleaching the colouring matter already oxidised and of neutralising the alkaline principles favourable to oxidation; 2 kilogs. of sulphate of alumina, perfectly free from iron, are added. The principal agent in this new bleaching process is the oxalic acid, the energetic action of which on vegetable colouring matters is well known. The sulphate of alumina added does not bleach of itself, but it forms with the colouring matter of the wood a nearly colourless lake, which enables the brilliancy of the product to be heightened.

On the 9th November, the following papers were brought before the Academy:—"On Isomeric Compounds of the Sulphocyanic Ethers, Homologues and Analogues of the Ethylic Essence of Mustard," by M. Hofmann; "On the Theory of Scintillation," by M. Jamin; "Effects of an Elevation of Temperature on the Calorific Phenomena Accompanying Electrolysis," by M. Raoult; "On the Pyrogenic Formation of Acetylene from the Benzilic Series," by M. Berthelot; "On the Atractylic Acid and the Atractylates, Proximate Constituents Extracted from the Root of the *Atractylis gummifera*," by M. Lefranc; "On a Method Suitable for the Formation of Emetics and Other Double Tartrates," by M. Henry; and M. Poulet addressed a note "On the Effects of the Carotid Injection of Alkaline Urates."

At the meeting on the 16th, the following memoirs were communicated. "On the Scintillation of a Reflected Light," by M. Chevreul; "Isomeric Compounds of Sulphocyanic Ethers," "Comparison of the Metamorphoses of the Essences of Mustard and of Sulphocyanic Ethers," by M. Hofmann; "Researches concerning the Mechanics of Atoms," by M. Lucas; "Experiments on the Electric Spark," by M. Seguin; "On the Theory of Electrodynamical Actions," by M. Reynard; "Determination of the Heat from the Combustion of Oil," by MM. Scheurer-Kestner and Meunier; "On the Production of Electric Discharges in the form of a Crescent by means of Holtz's Machine," by M. Gaiffe; and "On the Calorific Phenomena which accompany Electrolysis," by M. Raoult.

On the 23rd November the following memoirs were submitted to Academy:—"Thermal Researches on the Galvanic Battery," by M. Favre; "On the Behaviour of the Chlorides of Potassium and Sodium in the presence of certain Metallic Vapours, particularly Sodium Vapours," by M. Le Roux; "Researches on Nitrous Acid," by M. Chabrier; "Chemical Examinations of Five Samples of Gas from the Petroleum Springs of North America," by M. Fouqué; "On Cinnamate of Benzile," by M. Grimaux; "A Reclamation of Priority concerning the Chloride of Silver Battery constructed by Drs. Warren De La Rue and Miller," by M. Pincus, completes the list.

On the 30th November, MM. Milne-Edwards, Brongniart, Becquerel, Elie de Beaumont, and Coste were formed into a commission to propose a question for the Bordin

Prize in 1869. M. Becquerel presented a sixth memoir "On the Electro-Capillary Phenomena of Diffusion, the Formation of Oxides, Silicates, Crystallised Hydrated Aluminates, and the Effects of Diffusion between Liquids which do not Mix." The following other communications were also made at this meeting:—"On the Temperature of Flames and its relation to Pressure," by M. Deville; "Study of the Obscure Calorific Spectra," by M. Desains; "On some New Carbides of Hydrogen," by M. Fritzsche; "On a Phenomenon of Fracture produced in the middle of some Blocks of Tin by the Action of Intense Cold," by the same author; "On a Modification in the Humid Method of Estimating Silver," by M. Stas; "On the Applications of Aluminium Bronze," by M. de St. Cricq Casaux; and "On the Transformation Suffered by Molecular Granulations of various origin in Solutions of Cane Sugar," by M. Le Ricque de Monchy. M. Elie de Beaumont presented a specimen of devitrified glass, and pointed out the analogies presented by this specimen with certain rocks of igneous origin. M. Palmieri continues his study of Vesuvius, and describes the eruption on the 15th November; and M. Chacornac made known the results of his researches on the physical constitution of the sun.

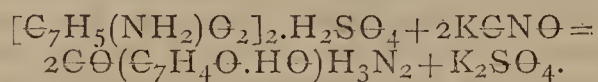
M. Le Roux has made some experiments with the vapour of sodium, and examined its capability or incapability of passing through rock salt. Two crucibles of rock salt were prepared, a thin plate of the same substance placed between them, and in one of the cavities sodium was placed. Notwithstanding a bright red heat maintained for several hours, the piece which was not in direct contact with the sodium vapour remained completely unaltered, even where it had been in contact with the plate already completely penetrated. Chloride of sodium is not attacked by the vapour of sodium, but soda corrodes it energetically. A very small quantity of soda suffices to hermetically seal two surfaces of rock salt, sodium preserving its lustre for several months in a crucible of this kind. Potassium vapour does not attack its chloride, but it covers the chloride with a bright blue substance in which, possibly, chemists recognise the suboxide of potassium.

M. Chabrier has studied at nitrification works, in particular circumstances, the different degrees of oxidation of the nitrogen, and especially nitrous acid. He has devoted attention to the estimation of this acid in saline mixtures, where nitrites and nitrates occur together with reducing agents. He submits to the Academy the result of the first part of his researches. The facts contained in this memoir are deduced from the following conclusions: (1) in liquids containing at the same time nitrites, nitrates, and organic matter, the nitrous acid of the nitrites may be determined by the decolourising action which hyposulphite of soda exerts on the iodide of starch, produced by the reaction of the nitrites on iodide of potassium in presence of starch and dilute sulphuric acid; (2) in the absence of nitrates and organic matter the determination could be more easily made by the decolouration of indigo solution, operating with the aid of heat, but out of contact with the air.

M. Grimaux prepares cinnamate of benzile by placing in a flask connected with a Liebig's condenser disposed inversely, alcohol, chloride of benzile, and dried cinnamate of soda. The cinnamate of soda being very slightly soluble it requires to be introduced in small portions at a time. The alcohol having distilled over water is added and the pasty deposit washed with an alkaline solution to remove cinnamic acid; ether is afterwards poured on and the deposit after this washing is dried over chloride of calcium, the ether removed by heating on the water bath, and the oily residue distilled in a vacuum. The distillate collected near 225° and 235°, cinnamate of benzile, is in the form of an oily liquid, which afterwards becomes a transparent solid. Cinnamate of benzile ($C_{16}H_{14}O_2$) occurs in small brilliant prisms, melting at 39°, and decomposing at about 350°. M. Fremy's metacinnamine appears to be pure cinnamate of benzile and not styracine (cinnamate of styrone) as MM. Kopp and Kraut have thought.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

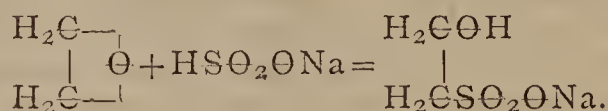
Action of Potassium Cyanate upon Amido-acids.—N. Menshutkin.—On mixing with a saturated boiling solution of sulphuric amidobenzoic acid, a saturated solution of potassium cyanate, oxybenzuraminic acid is formed, which, on cooling, separates in small crystals. The formation of this acid is shown by the following equation:—



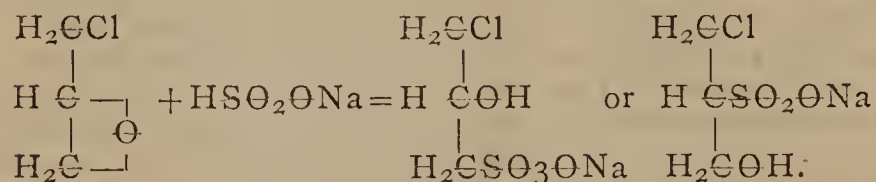
It is sparingly soluble in boiling water, better in alcohol, insoluble in ether; its salts are all soluble in water. Those which have been analysed (calcium, lead, silver) contained one atom of metal. The acid is readily nitrated by means of strong nitric acid. From amidoxybenzuraminic acid, and, perhaps, also from the amide of the oxy-acid, the author hopes, by the help of his reaction, to obtain oxybiureid.—*Zeitschr., Ch., N. F.*, iv., 275.

Notes by E. Erlenmeyer, L. Darmstädter, and Tscheppe:—

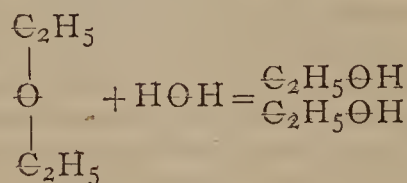
I. Synthesis of Isethionic Acid.—The sodium salt of this acid is readily formed if oxide of ethylene and sodium disulphite are heated together in a closed vessel to 100° C. The reaction is expressed by the following equation:—



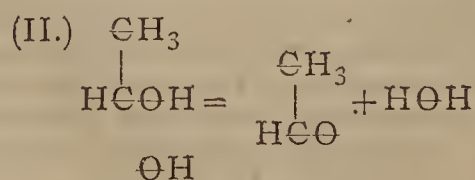
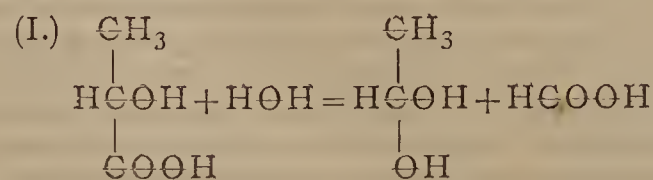
II. Formation of Chlorhydroxypropylsulphonic Acid (Chlormethyl-isethionic Acid).—Epichlorhydrin at 100° C. combines with sodium disulphite with formation of the sodium salt of the above acid, according to the equation—



III. Formation of Alcohol from Ether.—On heating ether with water to which has been added a small quantity of sulphuric acid for some time to between 150° and 180° C., the following reaction takes place:—



IV. Decomposition of Fermentation Lactic Acid.—This acid splits up into aldehyd and formic acid when heated for several hours with diluted sulphuric acid to 130° C. The reaction most probably passes through the following two phases:—



—*Ibid.*, N. F., iv., 341.

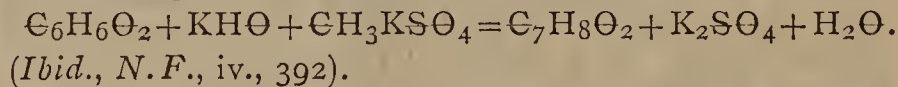
Dichlorphenol.—F. Fischer.—Dichlorphenol is obtained by passing a current of dry chlorine through phenol, and purified by repeated rectifications and recrystallisa-

tions from benzol. Thus prepared it is a solid body, crystallising in long white needles, which fuse at 42° to 43° C.; its boiling point is 209°, i.e., nine degrees lower than that of monochlorphenol, which boils at 218°. Dichlorphenol forms crystalline salts of no great stability. Its ethyl ether, $\text{C}_6\text{H}_3\text{Cl}_2\text{O} \cdot \text{C}_2\text{H}_5$, is obtained as a colourless oil boiling at 226° to 227°. It is readily converted into the nitro-compound $\text{C}_6\text{H}_2\text{Cl}_2(\text{NO}_2)\text{OH}$, which shows all the properties of that from the liquid dichlorphenol, as described by Laurent. Amidodichlorphenol may be obtained by the action of tin and chlorhydric acid upon the nitro-compound. It is described as a white crystalline body which, when moist, readily decomposes.—*Gött. Nachr.*, 1868, 171.

Behaviour of Metals in the Electric Current.—F. Wöhler. In addition to his experiments on silver (*CHEMICAL NEWS*, No. 463, p. 189), the author describes the following:—Palladium as positive electrode of two Bunsen's cells, immersed in acidulated (sulph. acid) water, becomes gradually covered with an almost black film of peroxide (PdO_2). Upon lead and thallium brown peroxide and black oxide are deposited. Osmium, in the ordinary porous condition, is freely converted into osmic acid (OsO_4). If, as electrolyte, a dilute solution of sodium hydrate is employed, the solution assumes a deep yellow colour, while, on the negative electrode metal is deposited. The same is the case with ruthenium. Osm-iridium in its natural state readily dissolves in the alkaline electrolyte.—(*Gött. Nachr.*, 1868, 169.)

Action of Iodhydric Acid upon Leucin and Tyrosin.—On heating in a sealed vessel pure leucin with fuming iodhydric acid to 140—150° C., for about 12 hours, the former takes up one atom of water and splits up into ammonia and capronic acid. Tyrosin, which is believed to contain ethylamine, was expected, under similar treatment, to yield that base, but instead of it ammonia was liberated. The author concludes from this experiment that tyrosine is not ethylamidoparoxybenzoic acid (Barth) but amidophloretinic acid, which, by the action of iodhydric acid, would break up into ammonia, phlorol, and carbonic dioxide; and, further, that the base which Schmidt and Nasse obtained by gently heating tyrosin is not ethyloxyphenylamine but amidophlorol.—(*Zeitschr., Ch., N. F.*, iv., 391.)

Synthesis of Guaiacol.—V. Gorup-Besanez. If a mixture of equal molecules of pyrocatechin, potassium hydrate, and potassium methylsulphate is heated in a sealed vessel to 160—170° C., a light brown, half-liquid mass is obtained which has all the properties of guaiacol. It is purified by repeated washings with water. Its formation takes place according to the following equation—



Sulphobenzyllic Acid.—O. Böhler. Benzyl chloride, $\text{C}_6\text{H}_5 \cdot \text{CH}_2\text{Cl}$, obtained by the action of chlorine upon toluol, is converted into the potassium salt of a new sulpho acid on being boiled with a solution of neutral potassium sulphite. The composition of potassium sulphobenzylate is $\text{C}_6\text{H}_5 \cdot \text{CH}_2 \cdot \text{SO}_3\text{K}$. The acid may be set free by decomposing its lead salt with hydric sulphide. It is very soluble in water and in alcohol. Fuming nitric acid replaces one H by NO_2 .—(*Ibid.*, N. F., iv., 440).

Ethyl Iodate.—K. Lisensko. A mixture of equal volumes of ethyl iodide and dry ether readily acts upon argentic iodate. If the temperature is not allowed to rise above + 10° C. the liquid remains colourless and the new ether undecomposed. The solution distils between 37° and 40°. The distillate at first floats upon the water with which it had been mixed, but on passing a current of air through the liquid, in order to drive off ethyl ether, it sinks to the bottom of the vessel. All attempts at further purification failed; the liquid boils at 75° under decomposition.—(*Ibid.*, N. F., iv., 455).

CORRESPONDENCE.

MR. BEANES'S PROCESS FOR TREATING ANIMAL CHARCOAL.

To the Editor of the Chemical News.

SIR,—In my paper on "Sugar Manufacture," reported in the CHEMICAL NEWS of the 18th inst., I have made a remark regarding Mr. Beane's process for treating animal charcoal with dry hydrochloric acid gas, which I find I am not in a position to substantiate, and which I therefore cancel. I beg also to express my regret for having published unadvisedly, and on insufficient evidence, a statement that might prove injurious to the interests of Mr. Beanes, and which that gentleman assures me is incorrect. I have elsewhere shown the superiority of the dry gas method over those formerly in use for removing calcic carbonate, &c., from charcoal; and while my opinion as regards the use of any of these processes in connection with sugar refining in this country remains unaltered, I am well aware that they are used with great advantage in continental factories where different circumstances obtain.—I am, &c.,

WM. WALLACE.

Glasgow, Dec. 28, 1868.

CHEMISTRY IN THE EXAMINATIONS OF THE DEPARTMENT OF SCIENCE AND ART.

To the Editor of the Chemical News.

SIR,—I am glad to find that my letter on the above subject has excited some little attention amongst your readers. One of your correspondents, "Woolwich," takes an objection to my statement, that of every ten chemical teachers not more than one has ever heard of "hydroxyl," and that of the remaining nine only one is likely to obtain any information respecting it from the ordinary manuals. Of course any estimate of this sort must necessarily be a matter of individual opinion, and I still retain mine, that taking the whole mass of teachers in this country, not one in ten ever heard of hydroxyl until they saw it in the recent syllabus of the Department; nor do I think that there is any discredit attaching to them for being unacquainted with it. The special theory of a particular teacher, almost entirely unnoticed by the ordinary works to which they are accustomed to refer to for information, and from which they have in past times derived their own knowledge, it is scarcely to be expected that they should know anything at all about. Your correspondent alleges that Dr. Frankland's views have been for some time before the world, and that they are shared in by other chemists of note. The first of these facts is unquestionably true, and the second probably is also, but that does not at all disprove my position that the theory of hydroxyl is altogether too new, too questionable, and too impractical to justify its being compulsorily taught to beginners, who have more than enough to do to learn the essential and most elementary facts of the science. I most fully admit that Dr. Frankland's hypothesis on this and other subjects are very ingenious, and have much to recommend them, but I am equally certain that if teachers are to be expected to communicate them to the average students who go up for the examination of the Department of Science and Art, their chances of success are infinitesimally small. I must fully coincide with your correspondent V. T. in his remarks as to the absurdity of expecting boys—and it must be remembered that most of the students in the classes for which the examinations of the Department of Science of Art are provided are really little better than boys in knowledge, even though they may be

in years—to answer questions which involve a knowledge of a terminology which, though admirable enough in its way, is not yet by any means even generally, to say nothing of universally, adopted. The fact is, that many examiners, though competent enough for their posts, as far as their personal capabilities as scientific men is concerned, are quite unfitted to conduct examinations of the kind of candidates with whom they have to deal. They have been accustomed to teach young men of some education, and often of much intelligence, who are able to give up a good deal of time to the study of special subjects, and they forget that the great majority of the students in the science classes, which are now being established with such difficulty in various parts of the country, have neither the time nor the capability to master more than the merest rudiments of science; and this applies also to a great extent to the science classes in middle class school. I shall look with some interest to the results of the next examination of the Department; for if, as things at present seem to foreshadow, they should show that the standard of the examinations has been considerably raised, I believe that a blow will be struck at science teaching in this country from which it will take years to recover.—I am, &c.,

A TEACHER.

MISCELLANEOUS.

The Royal Polytechnic.—The Christmas entertainments of this institution include a lecture, on "Singing and Sensitive Flames" by Professor Pepper, and "The Mysterious Hand," which proves the spirit wonder called the "Planchette" to be a piece of jugglery. The hand is placed on a sheet of transparent plate-glass, and it distinctly writes answers to any questions proposed, the answers being communicated to the querist on a card, thus furnishing him with a specimen of the mysterious handwriting. There is also a musical entertainment by Mr. George Buckland, called "An Eastern Story"; an instructive lecture by Mr. J. L. King, on the "Phenomena of Nature;" and a magical illustration of the Old German Story, "The Spectre Barber," by Mr. and Mrs. Coote. Professor Pepper continues his admirable lecture on "A Machine-made Watch," and other amusing entertainments are provided for Christmas visitors.

Detecting the Adulteration of Olive and Sweet Almond Oils.—Lipowitz has recommended the use of hypochlorite of lime, bleaching powder, as a means of detecting the adulteration of olive and also of sweet almond oil with the oil of poppy seed (Mohnöl). When eight parts of either olive oil or oil of sweet almonds is rubbed up and shaken with one part of bleaching powder and left at rest, it will be seen that even after some four or five hours a layer of clean and limpid oil separates and floats at the top and surface of the mixture, which layer is, if the oils operated upon are pure, at least half the bulk of the original mixture; if, however, poppy-seed oil is mixed with either of the two oils just mentioned, and the same experiment then repeated, the mixture gets the appearance of a liniment from which no oil separates. Sweet oil of almonds, adulterated with one-eighth part of poppy-seed oil, behaves as if it were almost pure poppy-seed oil. Büchner and Brande have found Lipowitz's statements correct as regards sweet oil of almonds but not as regards oil of olives; but they add that the olive oil they operated upon was already old. The action of Lipowitz's reagent is explained by the fact of the rapid oxidation of all so-called drying oils which, on drying, yield solid products before entirely changing, by continuously absorbing oxygen into water and carbonic acid. Linseed oil, hemp-seed oil, poppy-seed oil, oil from walnuts, croton oil, castor oil, are all drying oils. The

drying of drying oils is, in fact, a process of slow oxidation of these oils.—*N. Br. Arch.*

Silvering Glass Specula.—Several correspondents having made enquiries respecting Mr. Browning's silvering process we are induced to reprint the following:—

To Silver Glass Specula.—Prepare three standard solutions. Solution A—Crystals of nitrate of silver, 90 grains; distilled water, 4 ounces; dissolve. Solution B—Potassa, pure by alcohol, 1 ounce; distilled water, 25 ounces; dissolve. Solution C—Milk-sugar (in powder) $\frac{1}{2}$ ounce; distilled water, 5 ounces. Solutions A and B will keep in stoppered bottles for any length of time; solution C must be fresh.

The Silvering Fluid.—To prepare sufficient for silvering an 8-inch speculum:—Pour 2 ounces of solution A into a glass vessel capable of holding 35 ounces. Add, drop by drop, stirring all the time (with a glass rod), as much liquid ammonia as is just necessary to obtain a clear solution of the grey precipitate first thrown down. Add 4 ounces of solution B. The brown-black precipitate formed must be just re-dissolved by the addition of more ammonia, as before. Add distilled water, until the bulk reaches 15 ounces, and add, drop by drop, some of solution A, until a grey precipitate, which does not re-dissolve after stirring for three minutes, is obtained; then add 15 ounces more of distilled water. Set this solution aside to settle. Do not filter. When all is ready for immersing the mirror, add to the silvering solution 2 ounces of solution C and stir gently and thoroughly. Solution C may be filtered.

To Prepare the Speculum.—Procure a circular block of wood 2 inches thick, and 2 inches less in diameter than the speculum. Into this should be screwed three eye-pins, at equal distances. To these pins fasten stout whipcord, making a secure loop at the top. Melt some pitch in any convenient vessel, and having placed the wooden block face upwards on a level table, pour on it the fluid pitch, and on the pitch place the back of the speculum, having previously moistened it with a thin film of spirit of turpentine to secure adhesion. Let the whole rest until the pitch is cold.

To Clean the Speculum.—Place the speculum, cemented to the circular block, face upwards, on a level table; pour on it a small quantity of strong nitric acid, and rub it gently all over the surface with a brush made by plugging a glass tube with pure cotton wool. Having perfectly cleaned the surface and sides, wash well with common water, and finally with distilled water. Place the speculum face downwards in a dish containing a little rectified spirit of wine until the silvering fluid is ready.

To Immerse the Speculum.—Take a circular dish about 3 inches deep, and 2 inches larger in diameter than the speculum. Mix in it the silvering solution and the solution C, and suspend the speculum face downwards in the liquid, which may rise about $\frac{1}{4}$ of an inch up the side of the speculum. (The silvering will be completed in from 50 to 70 minutes, according to temperature; 50 minutes will be found sufficient in summer.) When the silvering is completed, remove the speculum from the solution, and immediately wash with plenty of water, using at least two gallons, and finally with a little distilled water. Place the speculum on its edge on blotting paper to drain and dry. When perfectly dry, polish the film by gently rubbing, first with a piece of the softest wash-leather, using circular strokes, and finally with the addition of a little finest rouge. A "flat" may be silvered by fastening with pitch to a slice of cork, cleaning as above described, and using as much silvering fluid as will form a stratum about $\frac{1}{2}$ inch deep beneath the mirror.

NOTES AND QUERIES.

Frosting Glass.—I should esteem it a great favour if you would give the method of frosting flint glass by the liquid as it is done on the Continent and in Stourbridge. I can do it with the fluoride of ammonium and hydrofluoric acid mixed together; the fluoride does

not mix with the acid, so I have to put it on with a brush, and it is very uneven and patchy. Perhaps some of those learned chemists who are connected with your valuable paper might be able to instruct me so that I could do it practically. There is a way to do it with the fumes, but it is a very old way and a very bad way, and so very unhealthy.—*R. B.*

The Lines in the Spectrum.—Several years ago, when Bunsen and Kirchhoff were in Paris, Plucker and Rhumkorff proposed to them a difficulty in "Spectrum Analysis," which they did not answer. I have long been waiting to see an answer. The difficulty is one which meets a person at his first trial of a spectroscopy. It is this:—The vapour spectra are bands, not lines, like Fraunhofer's, and these bands vary in width with the opening of the slit. Take, e.g., sodium. A candle held in front of the slit gives a variable band, not a line or pair of lines. It is not possible but that this difficulty has been most fully explained; but I have not been able to obtain explanation or conquer the difficulty with a plain spectroscopy. The sun lines are quite easily had, even with a common prism in the hand; not so vapour lines.—*E. K.*

MEETINGS FOR THE WEEK.

MONDAY, 4th.—Medical, 8.

— London Institution, 6.

TUESDAY, 5th.—Royal Institution, 3. Professor Odling, F.R.S., "On the Chemical Changes of Carbon."

WEDNESDAY, 6th.—Microscopical, 8.

— Pharmaceutical, 8.

THURSDAY, 7th.—Royal, 8 $\frac{1}{2}$

— Royal Society Club, 6.

— Royal Institution, 3. Professor Odling, F.R.S., "On the Chemical Changes of Carbon."

FRIDAY, 8th.—Astronomical, 8.

SATURDAY, 9th.—Royal Institution, 3. Professor Odling, F.R.S., "On the Chemical Changes of Carbon."

TO CORRESPONDENTS.

J. N. F.—There is danger of the subject of Science Teaching becoming wearisome to our readers.

E. K.—1. The new edition of Fownes's "Manual" will prove very useful in addition to Miller's "Chemistry." 2. See Notes and Queries.

Josephus.—Add hydrochloric or sulphuric acid to a strong solution of the salts. Benzoic acid will be precipitated, as it is much less soluble in water than succinic acid. The dry acids may also be separated by taking advantage of their different volatility.

J. Walton wishes to know of a book on colour making, applicable to the artists' colour business.

J. Wood.—1. We are not aware of any special work on the subject. 2. The best book on analysis is Fresenius's.

A Constant Subscriber.—Solid carbonate of ammonia will answer all your requirements.

J. Hardman.—Messrs. Truman, Hanbury, Buxton, and Co., have one of the ice machines you mention. One of 18-horse power would cost £2,000.

Communications have been received from Dr. Angus Smith, F.R.S.; S. Wilson; Dr. Odling, F.R.S.; Grimwade, Ridley, and Co.; J. R. Sawyer; J. L. Sinclair, Auckland, N.Z.; W. T. Suffolk; T. Dicker; Messrs. Townsend and Adams; F. B. Baker; R. Broadhurst; J. Wood; J. F. Sprague; Marshall Hall; Dr. H. Bence Jones, F.R.S.; H. Bassett; J. Watson; R. R. Tatlock; E. Kernan; the Prior of the Monastery of St. Joseph (with enclosure); J. Pryde; J. Mackie; Corbett and Wood; B. Nickels; U. J. Kay-Shuttleworth; and W. J. Bush and Co. (with enclosure).

BOOKS RECEIVED.

Histoire des Doctrines Chimique, Depuis Lavoisier jusqu'a Nos Jours. Par Ad. Wurtz. Paris: L. Hachette and Co.

Tweedie's Temperance Year Book of Facts and History. London: W. Tweedie.

The Journal of Materia Medica. New Lebanon, N.Y.: Tilden and Co.

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THE CHEMICAL NEWS.

VOL. XIX. No. 475.

ON THE CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(ADAPTED TO A JUVENILE AUDITORY),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN,
(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, Esq., M.B., F.R.S.

(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE I.

MARBLE—LIME—CARBONIC GAS.

MARBLE, a brittle solid, capable of being crushed and ground into powder—Its want of action on, and insolubility in, water—Occurrence of effervescence on treatment of marble with vinegar or acetic acid; also with other acids, as muriatic acid, for instance—Effervescence due to liberation of a particular kind of air or gas—Same kind of air or gas evolved from marble by action of a red heat—Marble resolved by ignition into above kind of air or gas, and a residue of quicklime—Resulting quicklime distinguished from original marble in various ways—Non-occurrence of effervescence on its being treated with acids—Evolution of heat on its being slaked by water—Its solubility in water—Lime-water characterised by its alkaline reaction upon vegetable colouring matters, and its precipitation of different metallic salts—Combination with lime of the air evolved from marble, to re-produce marble—Chemical identity of marble with chalk, limestone, calc-spar, coral, pearl, &c.—Solubility of all these substances in muriatic acid with effervescence, and their conversion into quicklime by ignition—Extinction of flame of ordinary combustibles by air evolved from marble—Combustion of different metals, as iron, zinc, magnesium, and sodium, in ordinary air—Combustion of sodium in air from marble, with separation of carbon or charcoal—Air from marble formerly called fixed air, on account of its being fixed or absorbed by lime, so as to produce chalk—Now called carbonic gas, from its containing carbon or charcoal—Production of carbonic gas by burning charcoal in ordinary air—Conversion of soluble lime into insoluble chalk or marble, a test for carbonic gas.

THOSE of you who are sitting in the front benches, and the no less youthful Fellows whom I see scattered about the theatre, who form my especial audience to-day, have, I suppose, most of you, very recently been acquiring at school much valuable knowledge with regard to words, and numbers, and events; and now in your holiday time, like many generations of schoolboys

before you, you come to the Royal Institution to learn a little about *things*—about material objects that can be touched and handled and weighed; and in a little time I think most of you will be surprised to find how very interesting and how curious the properties of even the most common-place things are when intelligently examined, and in particular how very remarkable are the changes which this common and, at first sight, uninteresting looking substance—charcoal—is capable of undergoing and effecting.

Now although it is my intention to talk to you about charcoal or carbon, I do not intend to begin with carbon, but with a very different looking substance—one which you may be inclined to think can have but little connection with charcoal at all, and yet which in reality, as I hope to show you, has a very intimate connection with it indeed,—I mean the substance I hold in my hand, and which you will at once recognise as a piece of marble—a slab of marble.

Now, as we have only some half-dozen hours to talk of the many wonderful changes of this wonderful charcoal, we will put aside all preliminaries, and begin at once with an experimental enquiry into the properties of this white substance, marble, and its relation to that black substance, charcoal. We will submit it to several tests or trials, and we will see how it behaves under those trials; and, first of all, we will try the effect of a blow upon it. If we take the marble, and hit it a rather sharp blow with a hammer, you will observe that the marble very quickly breaks to pieces. Here we have a number of similar pieces of marble that have been broken off in this manner; here we have a jar of broken marble, and here is the same marble in a smaller state of division. Now, if I take some ordinary pieces of marble, and put them into a druggists' mortar and bring the pestle down upon them, I have the power of reducing them to a powder of a greater or less degree of fineness. Here we have some marble which has been powdered in this manner; here is some in a rather coarser state; here, again, is some which has been very finely powdered for a special purpose; and by chemical means we can get the marble into a much finer state of division, which we speak of as precipitated marble. Well, then, the first thing we learn about marble is, that it is a very brittle substance. That is not a great deal to know, but it is something; and you will find in science that there is no fact, however small, that may not be found important. If I put a piece of lead under the hammer and strike it I cannot break it; or if I put a piece into a mortar I cannot powder it. Marble, then, is a substance entirely different from lead in these respects, inasmuch as the marble possesses

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property of brittleness which is not possessed by lead.

So much, then, for the effect of a blow upon marble. Now let us try it in some other way; and first of all we will treat it with water. In these vessels are two large thermometers, which I hope will be visible over the greater part of the theatre; one of these vessels contains a substance which is somewhat of the nature of common salt; it is not ordinary common salt, but it is a substance called salt-cake—a kind of salt that cakes together a good deal; in the other vessel there is common marble. Now we are going to wet both these substances, and to notice what happens. We will take a little water, and first of all we will wet this salt substance a little with the water, and observe what takes place. And, now, having wetted the salt substance, we will wet the marble, and notice whether any difference is observable between the two cases. I think that you will find, in the course of a very few minutes, that the liquid of this thermometer which is placed in the salt-cake, and which originally stood rather lower than the other thermometer, will rise rapidly, showing that we get a large amount of heat evolved. Salt cake, then, is a substance which, when moistened with water, gives out a considerable amount of heat; whereas marble is a substance which, when wetted, does not give out heat. You see that already the liquid in the thermometer connected with the salt cake is gradually rising, and it will go on rising, I have no doubt, until eventually it reaches up to the very top of the stem. [At a subsequent stage of the lecture the professor pointed out that the thermometer had risen to a considerable height.] We find, then, that there is in this respect a difference between the marble and the other substance.

And now let us try the effects of water upon marble in some other ways. You know that there are many substances which, when they are put into water, disappear; in other words, they dissolve in the water. Certain other substances do not disappear; you have a very good illustration of this in the case of sea salt and sea sand. You have observed, when you have been by the sea side, that the sea salt remains in the water, whereas the sand is deposited upon the shore. Now let us ascertain whether marble is a substance which, like sea salt, dissolves in water, or, like sea sand, remains undissolved. As I have compared the marble with the lead and with the salt cake, I will now compare it with certain substances which are soluble in water. Here I will take a substance which possesses a colour; it is some of the substance called aniline blue,—one of the colours made from coal tar. We will throw some of this blue colour into water, and now

notice what happens. You see the beautiful streaks of colour which are gradually descending. You see in this case, in fact, that we are dealing with a soluble substance—a substance which dissolves very rapidly in water, and by its solution gives rise to these beautiful streaks of colour. Here, then, we have an illustration of a substance which is soluble in water, and, at the same time, is possessed of a very brilliant colour. We will now pass on to the consideration of another substance. It is one which is not very soluble in water, but is very readily soluble in dilute spirit of wine. We take some of this substance, and put it into the funnel, and pour upon it some spirit of wine, and you see that in this case, also, the substance dissolves very readily in the liquid. You see at the present time a streak of red colouring matter gradually descending through the liquid. Here, then, you have another illustration of a substance which dissolves in water with tolerable facility.

Now, it is quite obvious, we must not compare marble with one of these beautiful coloured substances, but we will compare it with some colourless substance, and for this purpose I will take some common salt. Into this funnel I will pour a quantity of common salt, so as in a great measure to fill the funnel: you see the funnel is now filled with salt. In the other funnel we will place, in the same way, some marble, and we will notice whether any difference is observable in the case of the funnel filled with marble and the funnel filled with salt. In this experiment we shall not see streaks of beautiful colour, but I think those who are near will be able to observe that, in the case of the common salt, there is a stream of liquid—which is, in fact, a solution of salt—descending through the water beneath; whereas nothing of the kind will be observable in the case of the marble. Whether this is observable or not, there is one effect which I think will be noticed by all, and that will be that in the course of ten minutes or so the whole of the salt which we have put into this funnel will disappear, whereas the marble will remain.

We come, then, to this conclusion—that marble is a substance which, so far as we have gone, does not dissolve perceptibly in water. Here we have some marble in a bottle of water, and it is quite clear that the whole of the marble does not dissolve; but the question chemically is, has *any* of the marble dissolved? Has the water got any marble dissolved in it? I will show you the method which the chemist adopts for the purpose of determining this. He takes a funnel with some filtering paper in it, and he pours the liquid through the funnel; the object of this filtration being to remove any particles of marble which may be undissolved in the water.

The question then that we have to consider is whether the filtered water has got any marble in it, and to find out that point we take some of the water and boil it away. You know that when water is boiled it gradually gets less and less in quantity, and eventually it boils entirely away. Now if this water is *nothing but water*, it will boil away and leave no residue; but if it is water containing marble, the water will boil away, and the marble will not boil away but will be left behind; and thus when we want to know whether the water has taken any marble into solution we filter the liquid, in this way, and then boil it away, and observe whether there is a residue or not. So much, then, for the action of water upon marble.

The next substance of which we will try the action upon marble is a very common substance, namely, vinegar. For this purpose we will take some finely powdered marble and moisten it thoroughly with water, and then we will act upon it with vinegar. We pour some vinegar upon the marble, and notice whether or not any effect takes place. We shall see in the course of a minute or two that a considerable action is taking place; you will observe that the vinegar will become covered with froth. Now in this case the marble, which would not dissolve in water, is dissolving in the vinegar, and not only is it dissolving, but it is behaving very differently from the manner in which the common salt dissolved in this water [pointing to the solution of salt], and in which the magenta dissolved in this other vessel. You observe that the marble dissolves in the vinegar with a considerable amount of froth. Now what is the nature of that substance? Vinegar, you know, is a sour substance; to what does it owe this sourness? We find that it contains a sour substance called an acid. Chemists are acquainted with a large number of sour substances called acids, to which they have given different names. This acid contained in vinegar is called the *acid* acid, or *acetic* acid; but the amount of acetic acid existing in vinegar is extremely small. Therefore, if, instead of taking vinegar, we take some of the substance which gives its sourness to vinegar—the acetic acid itself—we shall find, in that case, that the action is much more decided. I will now employ acetic acid instead of vinegar, and you observe in this case that the marble dissolves with considerable rapidity, and we get in this case a much better marked effervescence than we had by means of the vinegar.

Now, as I have said, chemists are acquainted with a great number of different acids. There is this acetic acid, or the acid acid; then there is the acid which exists in sour grapes, and which is called tartaric acid; then there is an acid existing in sour lemons, called citric acid; there is an acid existing in apples, called malic

acid, and an acid existing in sorrel, called oxalic acid; then there is an acid got from sulphur, called sulphuric acid; another got from nitre, called nitric acid; and, lastly, there is an acid got from sea salt which is called muriatic acid. Now muriatic acid is the acid which we will try next.

You will find that muriatic acid is an acid which is much stronger than acetic acid, and that when we come to act upon marble with muriatic acid, we shall get a very much more rapid effervescence. In this case, indeed, the effervescence is so rapid, that I shall not need to employ the marble in the fine state of division in which it was when submitted to the action of the other acid. I will take some of this marble in the form of lumps, upon which the vinegar would be almost without action, and upon which the acetic acid would have a very small effect; but with the muriatic acid I can act upon the marble even in the form of these coarse broken pieces, and you see that in this case we get a very violent effervescence.

We have now ascertained these properties as belonging to marble—that when it is subjected to a blow from a hammer it breaks readily; that when exposed to the action of water it does not dissolve; and that when acted upon by vinegar, or acetic acid, or muriatic acid, it not only dissolves, but also gives rise to this phenomena of frothing or effervescence.

Let us now examine into the nature of this effervescence; and for this purpose we will try to perform the experiment in a somewhat different manner. I have here a jar containing some marble, and this marble is covered with water; at the top of the water is an inverted funnel, the object of which you will see presently. In this case, instead of using acetic acid, we will add some of the acid from sea salt, which we call muriatic acid; and you see that in this case we quickly get an abundant effervescence. We cover this with the funnel and fill up the vessel with water, and in a minute or two you will see what is the nature of this effervescence. You see that it consists in the formation of a large number of bubbles of air underneath the water; and here you see these bubbles of air rushing up through the neck of the funnel into the water above.

Now I wonder whether we can collect any of these bubbles of gas, and find out what sort of air they consist of; we will try. Let us take this glass cylinder and fill it with water, and invert it over the bubbles. If I were to invert the cylinder just as it is after being filled with water, you would find that the air would rush into the cylinder, and the water would simultaneously run out; but if I take the precaution to cover the mouth of the glass with a card, and

then invert it so as to keep out the air, under those circumstances the water will remain in the cylinder perfectly well. The air cannot get in, and consequently the water cannot get out. If I put this card on the end of the glass cylinder, I prevent the air from gaining access, and consequently the water does not escape; when the air cannot get in, the water cannot get out.

I have here another arrangement of the same kind, and by it we will now endeavour to collect some of the gas which is coming up from the marble. I take here a tube, filled with water, and instead of closing it with a card I simply close it with my thumb, and support the end of it under the water over the bubbles of gas; and in this manner, no doubt, we shall be able to collect under the water some of these bubbles of air or gas which are rising from the marble, and which have been generated by the action of the muriatic acid upon the marble. We will now try to get some more of this gas of marble, by acting upon the marble by acid in a bottle instead of in a cylinder. Here is some in a bottle, and in this way we get a considerable effervescence; we put into the neck of the bottle a cork, with a piece of bent tube attached to a piece of vulcanised tube. You see that here we get a jar full of gas in a minute or two, for we are now performing the experiment on a somewhat large scale, while in the other case we performed it on a small scale. This effervescence consists in the formation of bubbles of air beneath the surface of the water, and these bubbles of air we are capable of collecting. In a minute or two we shall have this jar full of the air which is given off from the marble, and then, having obtained it, we shall be able to ascertain its nature. The vessel is now full of the air from marble, and so we will close it with a glass plate and put it aside for a minute or two, until we require it.

We have, then, tried the effect of water and of acids upon our marble; now let us try the effect of heat upon it. For this purpose we will take some of our finely powdered marble, and subject it to the action of a strong heat; and at the same time that I pour some of the marble into this capsule I will also pour some more of the same marble into a glass which shall stand by the side of the capsule, so that when the experiment is complete we may know that we have two specimens of the same substance—one of them being the substance before the action of heat upon it, and the other being the same substance after it has been acted upon by heat. We will take this platinum dish or capsule containing the marble, and act upon it by a strong heat. I will let it be uncovered at first, so that you may see how hot it becomes, and then, in order that the heat may be greater, we will cover it up with this platinum cover, which will cause it to become still hotter. [The dish containing the marble was then sub-

mitted to a blowpipe flame]. But I will also expose some marble to heat in another way; instead of putting it into a dish we will put it into this platinum tube, and having filled the tube with marble we will heat it very strongly, and notice what happens. Our tube is now full of marble; we will, therefore, insert in one end of it a cork having a glass tube passing through it, and we will now heat the platinum tube very strongly by means of a blowpipe flame; but before we submit it to the heat we will attach to the glass tube an apparatus for the purpose of ascertaining whether or not any kind of air or gas is given off under these circumstances. For this purpose we will take another glass cylinder and fill it with water and invert it in a dish of water over the end of the tube from which the bubbles of gas would issue, just as we did in the other case. We are now making our platinum tube very hot by means of the blowpipe, and you will notice in a minute or two whether or not any gas is being evolved. We dip the mouth of the tube underneath the cylinder of water, and you will see that one of the effects of heat upon the marble contained in the tube is to drive off a kind of air or gas.

The point, then, to which we have now arrived is that, whether you act upon marble by an acid, or act upon it by heat, in either case you get evolved a particular kind of air or gas, into the properties of which air or gas we will presently enquire.

The question, then, that arises is this. What is the nature of the gas or air which is given off in these cases? Is the same kind of air given off by the marble under the action of heat as is given off by it under the action of the acids, or is it a different kind of air? Well, the only way to answer this question, as to answer a great number of others, is to try it. We will try whether the kind of air that is given off by the action of heat is the same kind of air that is given off by the action of the acid, or a different kind of air; and for this purpose we will examine more particularly the nature of the air that is given off by the marble through the effect of the acid upon it. We will take a solution containing lead, which is very well known to medical men under the name of Goulard solution; it is a solution of basic sugar of lead. We will allow the gas given off by the marble to bubble up through our solution of basic sugar of lead, and see whether any action takes place; we see, in point of fact, that there is an effect, and that the solution is rapidly becoming milky. We will now take another portion of the gas given off from the marble under the action of the acid, and try in another way what its properties are; we will take a piece of lighted stick and immerse it in the gas, and it is, as you see, immediately ex-

tinguished. Thus we find, then, that the air which is given off from the marble by means of the acid has these two properties; it renders the sugar of lead solution white and turbid, and it extinguishes flame. We will now take a jar of the gas obtained from marble by the action of heat, and observe the effect of this gas upon the solution of sugar of lead. We cause some of the gas that has been produced from the marble by heat to bubble up through a solution of sugar of lead, and you see that in this, as in the other case, the gas evolved from the marble has the property of rendering the basic sugar of lead turbid, just as did the gas evolved from the marble by the action of the acid. In this respect, therefore, the gas evolved from marble by these two different agencies appears to be the same in both instances. Now we will ascertain whether the gas which is evolved from marble by the action of heat has also the property of extinguishing flame. For this purpose we will get our cylinder full of the gas which has been expelled by the heat from the marble, and you see that directly I put in a lighted taper it is extinguished by the gas contained in the cylinder. We have therefore tried the gas produced by these two different methods, and we find that it behaves in the same way in both cases, as far as we have experimented; and, in fact, I may tell you that, no matter how you subject to trial the gases evolved under these different kinds of action, you will find that they always behave the same, or, in other words, that the air given off from marble by the action of heat is identical with the kind of air given off from marble by the action of acids.

Now let us see what sort of a substance is the residue which remains behind; and for this purpose we will examine the substance which we have been subjecting in this way to the action of heat. You will remember that in this beaker we had some of the original marble which we did not expose to heat; and now we will take some of the marble which has been exposed to heat, and see whether or not any difference is observable in the behaviour of the two sorts. Inasmuch as it is possible, or, in fact, very probable, that the action of the heat may not have been pushed sufficiently far, we will not take the whole of the marble which has been exposed to heat, but only a portion of it, and the remainder we will continue to submit to the action of the heat a little longer. Before experimenting with this portion of the marble which has been strongly heated, we will wait a minute or two, that it may become a little cooler; at present it is so hot that I am not well able to bear my hand upon it. When it is cooler I will try the effect of water upon it, and we will see whether the marble which has been thus heated behaves in a different way from the marble which has

not been heated. (It is now practically cold; if not absolutely cold, but I can bear my hand upon it.) You will now observe that directly I moisten with water this marble which has been heated, it gives out a great amount of heat and a great quantity of steam, and has now become so hot that it is impossible for anyone to bear his hand upon it; whereas this marble which has not been submitted to the action of heat, is quite unaffected by the water with which I moisten it.

We will now go on a little further, and notice whether that marble which has been so strongly heated will effervesce under the action of an acid, and if it does effervesce, whether it effervesces to the same extent as the other marble. In the case of the marble which has been heated, you see we get some effervescence, although not in the same degree; and I am in hopes that in a short time, when the remainder of the heated marble has been subjected to the heat a little longer, we shall get a product which will give us no effervescence.

Hitherto I have been talking about the observation of facts; here, you see, we have got a fact which I did not want, for it was my intention that the marble which had been heated should not effervesce. Now, in science we must interpret the language of facts as they arise. This is an awkward fact; why did it happen? It was because we did not allow the action of the heat to continue sufficiently long. We shall have to go over the experiment again, but for the present you must take my word, that if the marble had been ignited sufficiently long it would no longer have been able to effervesce. I will give you another illustration of the great amount of heat that is produced by this residue when it is wetted. Here we have some large pieces of the residue left after ignition, and upon moistening them we shall get a very considerable amount of heat evolved. You will see the mass begin to steam in a minute or two. It already gets very hot; and if I place upon this mass of residue that has been left after the ignition of marble, a piece of phosphorus, you will see that the phosphorus will, in a minute or two, burst into flame. You see the phosphorus now takes fire from the heat that is in this way produced by wetting with water the residue left by the ignition of the marble. Thus you see that the substance which is left by the ignition is a very different substance from the original marble with which we began the experiment. Now we will take a little more of this marble residue, which we will also wet with water, and we will notice whether or not any other remarkable effect takes place through the action of the water. We here take our marble which has been burnt, and we will notice whether or not we get any solution; and for that purpose we will treat this liquid which we pour upon it exactly in the same way as we treated the liquid

that was obtained by the action of water upon the marble before it was burnt—that is to say, we will filter it—and then we will take the liquid obtained by the action of water upon the residue of the ignition of marble, and ascertain whether or not water, which would not take up anything from the original marble, will take up anything from this residue of ignited marble. Here I have some of this solution being made—it is filtering through the funnel; but here I have some of the solution already made. First of all we will try its effect upon this piece of paper. Here is a piece of paper almost colourless: we dip it in the solution, and we find that it is dyed almost purple, showing that the water which has been obtained in this way has got something in it. Here is another piece of paper; let us see whether the solution has any effect upon that. You will observe, on my taking out this piece of paper, that, whereas the first piece was stained of a bright red colour, this piece is very quickly stained green—not, I think, so decided a green as the other was a decided red, but still I think it is very apparent; you see, then, that the product obtained by the action of water upon the residue of ignited marble has certain properties. Here we have another piece of paper, and you see that it is dyed brown by the action of the liquid. Here we have a piece of paper which is already red, and on our allowing this to come into contact with the liquid it becomes of a decided blue colour. In this way, then, we are able to ascertain that the liquid that filters away from the residue of the ignition of marble has the property of effecting these bodies in these different ways. But we will try its properties in another way. Here are some vessels containing certain metallic solutions. You will find that the water which has been allowed to digest on marble which has not been ignited, has no effect on the solutions, except that it makes them of a somewhat paler colour by diluting them; whereas I hope to show you that the water from the marble after it has been heated, has a very decided effect. [Portions of the liquid filtered from the calcined marble were added successively to the various metallic solutions.] Here we get a blue precipitate; here we get a black precipitate. To this we add some of the liquid in the same way, and we get a brown; into this, again, we put some of the liquid from the ignited marble, and we get a green; here, again, we get an orange colour. Lastly, we add some to this solution in the same way, and we get a white precipitate. Hence you see that, while the water filtered from the unburnt marble has no effect upon these solutions, the water which has acted upon the marble after ignition produces a very decided effect.

Now, what is the nature of this substance

which is left behind after the ignition of the marble? Well, this residue is known as “quick lime.” When you heat marble in this way you get a substance which differs very much from the original marble; it is no longer marble at all; it has not the property of effervescence with acids, but it has the property of forming a solution with water and giving out heat when moistened. Marble is a substance which does not give out heat on being wetted, and does not dissolve; marble effervesces with acids, but the quick-lime does not. So much, then, for the residue.

Now, what is the nature of the gas that is produced when the marble is heated and the residue of quick-lime is obtained? Here is an arrangement for obtaining the gas rather more convenient for lecture purposes than the one we employed before. It is exactly of the same character, only in this we have the marble in a separate vessel, and the acid can act upon it at leisure. Here we take some of our lime water, and we cause some of this gas to bubble through it, and we notice what effect takes place. When we allow the acid to come into contact with the marble we get an abundance of the air or gas given off, and we found that the same air or gas was given off by the marble whether through the action of acid or of heat. We allow some of this gas to act upon this lime water, and we find that we get a substance identical with the original marble with which we started. We will try this product, and I have no doubt those who are near me will see that a gas is given off when I add muriatic acid to it. [The precipitate effervesced on being treated with acid].

From what we have seen, then, we conclude that the lime differs from the original marble in the absence of this particular kind of gas or air which the marble gives off when it is heated, and you noticed just now that when we caused this gas to combine again with the lime we got a substance possessing the properties of the original marble; and if we took this precipitate from the lime water and acted upon it with muriatic acid, you saw that we got the gas once more driven off, and the precipitated marble dissolved. The precipitate which was produced we say is chemically the same thing as marble.

Now let me call your attention to some other kinds of marble. Here is a piece of coral; here is a piece of stalactite; here is a piece of calcareous spar; here is a piece of limestone; and here is a piece of shell. If we take, for instance, some of these shells, and cover them with water, and act upon them with muriatic acid, we shall get in this case, as in the other, a considerable amount of effervescence, due to the solution of the shells in the acid and the giving off of a gas. Directly we pour some of this acid upon them, the shells undergo solution, and immediately

they effervesce. Well, not only will shells or limestone act thus, but also pearls. For instance, if we take some pearls and act upon them with hydrochloric acid we shall find that the pearls dissolve and give off gas. I have spoken of this gas as being the gas of marble; I might equally well call it the gas of pearls. We moisten these pearls with water, and act upon them by muriatic acid, and we get in this case a rapid effervescence, and in this way we might collect the gas given off by pearls. You will remember, I dare say, the story of Cleopatra melting her pearl ear-rings in vinegar; well, all I can say is that either her vinegar must have been extremely strong, or she must have taken a very considerable time about it, for pearls dissolve very slowly in vinegar, though they dissolve more readily in this strong muriatic acid. We will facilitate the action of the muriatic acid upon the pearls by the application of a gentle heat, for, in the case of the pearls, although the substance is chemically identical with marble, it is in so compact a state that even the muriatic acid acts upon it very slowly, and the vinegar which Cleopatra employed scarcely acts upon it at all. Here we are collecting our gas from the pearls, and the action will go on in this way until we get our cylinder full of the gas.

I now want to call your attention, for the two or three minutes that remain, to some of the properties of this gas; first of all with reference to the combustion of metals in it; for although the gas given off from marble is not capable of supporting the combustion of ordinary combustibles, nevertheless it can support the combustion of some bodies. In the first place, in order to prove to you that metals will burn, I will show you the combustion of certain metals in air, and then we will take one of them and burn it in the same manner in the gas given off from marble.

I will here ignite some zinc, and then blow a current of air upon it, and you will find that in this way the zinc burns very readily in a current of air. Zinc, then, is a metal capable of burning very readily in air. Now let us try the combustion of the metal magnesium in the air; you have seen that metal burn in the air on several occasions. Here is a piece of magnesium burning in the air very readily and with considerable brilliancy. Now I want to show you the combustion of a metal, both in air and in the gas given off from marble, and that metal is not either of these that we have yet considered; it is the one which I am now about to ignite—metallic sodium. It is now beginning to burn with very great brilliancy, and whilst it is burning let me draw your attention to the remarkable appearance which that coloured diagram presents when illuminated with the light given off by burning sodium. What

were seen to be brilliant colours when the magnesium was burning, now look perfectly black under the influence of the sodium light.

The only other experiment to which I wish finally to call your attention, is the combustion of this metal—sodium—not in ordinary air, but in the particular kind of air that is evolved from marble. We take, here, our apparatus which is giving off the gas from the marble, and we cause this gas to flow through pumicestone, moistened with oil of vitriol for the sake of rendering it dry, and then we will receive it into this flask. We next heat our sodium as we did just now, except that instead of heating it in the open air we will heat it in the flask in a current of this gas, and I want to show you then what the effect will be. [A piece of sodium was deposited in a flask which had been filled with the dried gas; the sodium was then ignited by the application of a blow-pipe flame to the exterior of the flask]. The sodium has now, you see, taken fire, and is burning in the gas contained in the flask; and now the only other point that I have to call your attention to is the result of this burning. When we come to examine the contents of the flask, what do we find as the product of the combustion of the sodium in the gas evolved from marble? As soon as the mass at the bottom of the flask ceases to be red hot, I will call your attention to its appearance. You now see that we have here a solid mass of that black substance—charcoal—to which I directed your attention in the beginning of the lecture. Well, now, where did this piece of charcoal come from? This piece of charcoal could not have come out of the sodium, and for this reason,—that if you take this metal and burn it in the air, or in any other gas or under any of the conditions under which sodium is capable of burning, in no case do you get this charcoal except when it is burnt in this gas which is given off by marble. The point, then, to which we have arrived at the conclusion of this lecture is—that marble is capable of giving off a certain kind of air or gas, and that this air or gas contains charcoal as its essential constituent.

Professor Kopp.—From a letter just received from Professor Emile Kopp, we understand that he is on the point of quitting Saverne to reside at Turin, where he has been appointed Professor of Technological Chemistry and of Metallurgy in the Royal Museum of Italian Industry. Large laboratories are about to be erected under his superintendence, in which practical work will supplement theoretical teaching. We understand that these appointments have been offered to Professor Kopp by the Italian Government, and he has been induced to accept them in the expectation of having more time at his disposal for original research. After some remarks concerning the *CHEMICAL NEWS* highly flattering as coming from such an eminent chemist, he promises to forward occasional contributions from his laboratory and records of the progress of science in Italy.

ON THE
IMMEDIATE ANALYSIS OF METEORIC IRONS.*By STANISLAS MEUNIER,
Aide Naturaliste at the Museum of Paris.

(Concluded from page 5.)

IV. SCHREIBERSITE.

I prepare schreibersite, or phosphide of iron and nickel, by the same method as troïlite.

Besides, as for the latter, it is always preferable to take the schreibersite in the places where it is naturally concentrated.

It is a metallic matter, yellowish or almost white. Its specific gravity is 7.103, and I have found in the schreibersite of Toluca's iron :—

Iron	57.11
Nickel	28.35
Cobalt	trace
Magnesium	trace
Phosphorus	15.01
	100.47

These numbers lead to the formula $\text{Fe}_4\text{Ni}_2\text{P}$, yet admitted by Mr. Smith after the analysis of the Tazewell's schreibersite. My confirmation is the more interesting in that Bergemann, analysing the same substance as I, but impure, found—

Iron	87.0
Nickel	9.5
Phosphorus	3.5
	100.0

Schreibersite is magnetic, and takes permanent polarity by contact with a magnet. It is brittle. Hydrochloric acid has no action upon it. Crystalline forms have not as yet been observed.

V. GRAPHITE.

Graphite may be isolated by the following method :— A few grammes of metallic powder are projected into fused potash, and thus a mixture of nickeliferous iron and graphite is obtained. This mixture may be treated in several ways.

1st. Iron is dissolved in chlorhydric acid, which leaves as residue the graphite almost pure.

2nd. The graphite is separated by lixiviation. This process presents the advantage of giving both graphite and nickeliferous iron; but the separation is never complete.

3rd, and lastly. The magnet may be employed only when the graphite is abundant; in other cases it is drawn up with the metal.

In all cases the residue is washed by chlorhydric acid to dissolve foreign matters, such as troïlite and schreibersite, or what results from their being attacked by fused alkali.

The graphite extracted from the Caille iron shows a density equal to 1.715. Its analysis gave—

Carbon	97.3
Iron	2.4
Nickel	trace
	99.7

The graphite of the Charcas iron has a density of 1.309, and this is the result that I have obtained in its analysis :—

Carbon	98.0
Iron	0.9
	98.9

The graphite is remarkable on account of its great unalterability.

VI. EXTERNAL CRUST.

The portions of meteoric iron, upon which is the crust, being separated by means of a saw, they are placed in a concentrated solution of bichloride of mercury. After a sufficient time all metallic particles are dissolved, and the oxides, amongst which is the crust, remains alone.

However, the crust is still mixed with foreign matters. Usually there is with it the products of its alteration by atmospheric agents, and particularly limonite. Some schreibersite, troïlite, and stony grains may be also mixed with the principal substance, and their separation is very difficult.

Weak chlorhydric acid carries away limonite and troïlite; stony grains remain as residue after the action of the magnet; lixiviation permits the purification of the crust from schreibersite.

Besides, these operations may be simplified by choosing the portions of the crust that seem almost pure. They frequently detach themselves from the subjacent metallic matter.

Very few chemists have analysed the external crust of meteoric irons. The analyses given by Pugh, as showing the composition of the crust of the Toluca iron, have evidently been executed on an impure mineral. As it is precisely the crust that I have examined myself, I will record Pugh's results :—

Metallic iron	18.717
Protoxide of iron	19.309
Sesquioxide of iron	32.750
Protoxide of nickel and of cobalt	5.751
Chalk	trace
Silicates	10.203
Water	13.270
Chlorine	trace
	100.000

Evidently metallic iron, silicates, and water are not essential elements of the crust, and must be considered as impurities.

Having purified as much as possible by the method above described the crust of Toluca iron, I have found for it a density of 4.89, and the following composition :—

Sesquioxide of iron	6.893
Protoxide of iron	28.12
Protoxide of nickel	2.00
Protoxide of cobalt	trace
	99.05

These numbers agree with the formula $\text{Fe}_2\text{O}_3, (\text{FeNi})\text{O}$, which does not differ from that of magnetite, except by the substitution of a small portion of nickel for a corresponding quantity of the iron of the protoxide.

It is remarkable that, if in Pugh's analysis we only consider sesquioxide of iron, protoxide of iron, and protoxide of nickel and of cobalt, we arrive at numbers very near to those required by the above formula.

VII. STONY GRAINS.

Several of the operations described above may evidently serve to prepare the stony grains in a state of purity. But this is how the separation must be made when it is especially intended to obtain these grains.

Iron in form of lumps is left protected from the contact of the air in a concentrated solution of bichloride of mercury, and frequently stirred. After a sufficient time the metal disappears, and the liquid contains stony grains mixed with protochloride of mercury, and generally with a small quantity of metallic mercury. There is also troïlite, schreibersite, and graphite. A solution of chlorine carries

off the calomel, and the magnet isolates the schreibersite and the troilite; lixiviation may be employed to get rid of graphite.

In certain cases, time can be saved by submitting to the action of a current of hydrogen the magma produced by the action of the bichloride. Heat carries off the calomel, the mercury, the troilite, and the schreibersite. The stony matter is purified from graphite by lixiviation.

If the stony grains (as is the ordinary case) are not oxidisable, hydrogen may even be replaced by air, which burns the carbon and gives directly the stony grains perfectly pure.

These grains are of different composition, and it appears that there exists a certain relation between their composition and their situation. Some are localised in the iron; others are situated in the troilite, or, perhaps, in the graphite which surrounds this sulphur.

The grains of the first category may be found in meteoric irons of Tazewell and of Tucson. They are formed of peridot, which is proved by the analyses published by Mr. Lawrence Smith. I have studied those grains, and found that their density is equal to 3.35. I have not observed crystalline forms.

The grains of the second category were given by the troilite of the Caille iron. Their quantity was too small for me to be able to analyse them, but I have submitted them to the blowpipe assay. Those grains are not fusible, and gave nothing but the reaction of silica.

The troilite of Charcas iron gave me analogous results.

VIII. GASES.

Gases have been recognised in the meteoric iron of Lenarto, by M. Boussingault and by Mr. Graham.

I have sought the same bodies in another iron of the same origin by means of the solution of those masses in concentrated bichloride of mercury. The results were that gases do not exist in appreciable quantity in the irons of Caille and of Charcas. The mass of Krasnojarsk (Siberia) gave me a small bubble of gas, having the composition of atmospheric air; but it must be remarked that this iron was cracked.

IX. RARE SUBSTANCES.

In concluding this enumeration, I must mention chromite and protochloride of iron, which appear in certain irons. Their separation is evidently easy, and their composition is identical with that of analogous terrestrial compounds.

After having described the methods which have permitted me to separate in a state of complete purity the *immediate principles* of meteoric irons, I will remark that those methods can be employed to estimate the relative quantity of the substances in question.

I have, for instance, submitted to a *quantitative immediate analysis* the meteoric iron discovered in 1784, at Xiquipilco, in the valley of Toluca (Mexico), and I have found in it—

Nickeliferous iron	..	..	..	96.301
Graphite	..	..	..	1.176
Troilite	..	..	..	1.482
Schreibersite	..	..	..	1.232
				100.191

I will remark upon this subject that those numbers are exact exclusively for the analysed specimen. In other parts of the same mass, crust, stony matters, &c. may be found, and perhaps some of the above-named principles can disappear.

I will show in another paper how my studies have given me a good rule for the classification of meteoric irons.

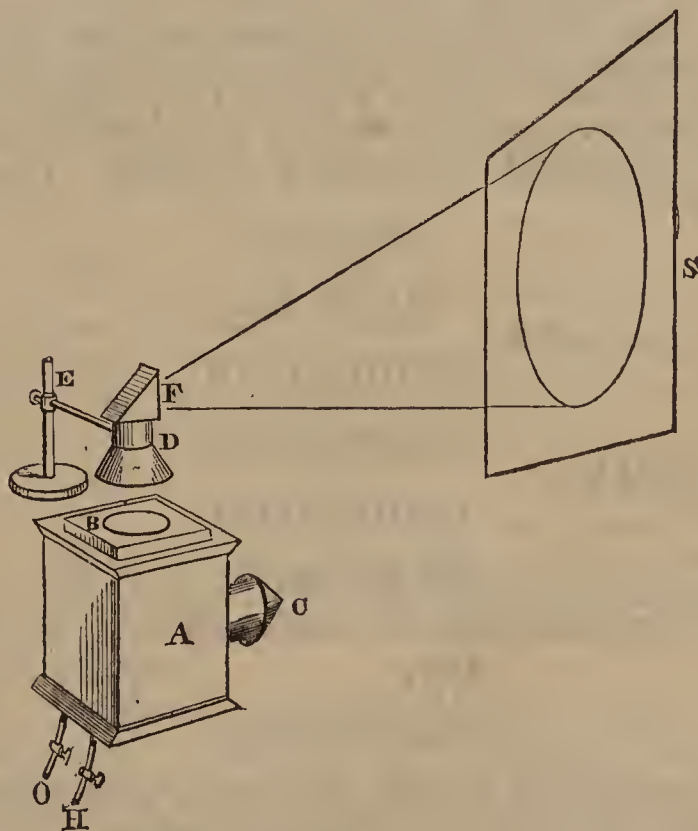
Paris, November 27th, 1868.

ON THE EXHIBITION OF COHESION FIGURES TO A LECTURE AUDIENCE.

By C. J. WOODWARD, B.Sc.,
Lecturer on Chemistry and Physics, Midland Institute, Birmingham.

WISHING to exhibit the singular figures discovered by Professor Tomlinson, and known as cohesion figures, I proposed adopting the method mentioned by Mr. Reynolds in the *CHEMICAL NEWS* of November 27th; but it occurred to me that an arrangement similar to that used to show waves in water would probably serve the purpose. I therefore tried the following plan, which, though not so successful as the one I shall afterwards describe, is well worth trying:—A box with a glass bottom was filled with water and a lime light placed underneath the box. On throwing a spot of liquid, giving a cohesion figure, on to the water, the figure, more or less definite, was exhibited on a tracing paper screen placed above the box. Even with a candle underneath the box the figures were visible, but of course not sharp as when the oxy-hydrogen light was used. This experiment led me to devise the following arrangement, which, with such liquids as I have tried, serves admirably, the figures being projected on to the screen with great clearness:—

In the first place several troughs are made to hold the water on which to place the creosote, &c. Those I have are made of plate glass. A piece of glass 5 inches square and $\frac{1}{8}$ inch thick has a hole 3 inches diameter cut in it, and this, when laid on a plain piece of glass, forms a circular trough, 3 inches diameter and $\frac{1}{8}$ inch deep. An ordinary oxy-hydrogen lantern, from which the nozzle has been removed, is now tilted back so that the light from the lantern is thrown perpendicularly upward, and the trough placed just over the front of the lantern as though it were a lantern slide. The nozzle of the lantern, fitted to a projecting arm, is then brought over the trough and an image of the upper surface of the water obtained on the ceiling. On now placing a drop of creosote on the



water an image of it is seen on the ceiling. If it be desired to throw the image on to a vertical screen, a reflecting prism is placed on the nozzle, by which the desired effect is obtained.

The arrangement will be completely understood by referring to the accompanying figure, in which A is the lantern turned back; C, the chimney; B, the glass trough to hold the water on which the creosote or other liquid is

placed; D, nozzle of lantern, supported by the horizontal arm E; F, reflecting prism; S, screen on which the image is received.

It should be mentioned that it is necessary to remove the usual taper pipe of the nozzle of the lantern, and substitute a shorter one, so that the figures may be properly focussed, and yet room enough left to introduce a pipette between the nozzle and the trough containing the water.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

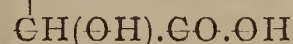
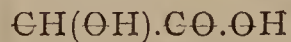
Sulpho-acids of the Hydrocarbons C_9H_{12} .—O. Jacobson has examined the sulpho-acids and their salts of the isomeric hydrocarbons C_9H_{12} , and he has found that they are sufficiently distinguished from each other to serve as means for identifying the hydrocarbons. Cumol, prepared from camphorone by the action of fusing zinc chloride, although its formula appears to be C_6H_5 (C_3H_7) (Fittig, *Ann. Chem. Pharm.*, cxii., 309), differs from propylbenzol (derived from cuminic acid). A statement, Church's, that a hydrocarbon of the formula C_9H_{12} was formed by dry distillation of barium eugenate, the author has not been able to confirm.—(*Ann. Chem. Pharm.*, cxlvi., 85.)

Composition of the Crystals of Sodium Ethylate.—A. Geuther and E. Scheitz.—The transparent crystals which are obtained by dissolving sodium in absolute alcohol and allowing the heated solution to cool, have the composition $C_2H_5NaO \cdot 2C_2H_6O$. They are soluble in ether. In a vacuum over sulphuric acid they gradually lose the two molecules of alcohol, and are converted into sodium ethylate, C_2H_5NaO .—(*Jen. Zeitschr., F. M. and N.*, iv., 16.)

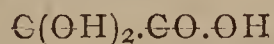
Formation and Constitution of Racemic Acid.—A. Strecker. In consequence of the relation existing between succinic and tartaric acid, the constitution of the latter (and doubtless also of paratartaric and the other modifications of tartaric acid) may be inferred from that of the former. Various formulæ for tartaric acid are possible according to whether the part C_2H_4 in succinic acid be considered as ethylene or ethylidene. If succinic acid is—



tartaric acid will be—



or it might be—



but if the constitution of succinic acid is—

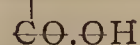
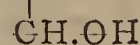
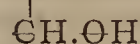


then a number of formulæ for tartaric acid may be set up, in all of which, however, the two atoms of carbonyl would be attached to the same carbon atom. Assuming the first formula of tartaric acid to be the correct one, the author endeavoured to obtain that acid from glyoxal,



by the introduction into it of $H.CO.OH$, i.e., by treatment with hydric cyanide and chloride. On mixing an

aqueous solution of glyoxal with an excess of cyanhydric acid and some chlorhydric acid, boiling for several hours, evaporating on the water bath, and adding to the residue milk of lime, a calcium salt is obtained which is partly soluble in acetic acid. The insoluble portion was converted into lead salt, and this decomposed by hydric sulphide. The acid solution thus obtained gave, on evaporation, crystals of racemic acid, $C_4H_6O_6 + H_2O$. The acid is formed according to the following equation:— $C_2H_2O_2 + 2CNH + 4H_2O = C_4H_6O_6 + 2NH_3$. By this synthesis the constitution of this modification of tartaric acid is proved to be the following:—



An analogous structure no doubt belongs to the other modifications of tartaric acid.—(*Zeitschr., Ch., N. F.* iv., 216.)

Nitroglycerin.—F. Tilberg. Nitroglycerin (from the works at Stockholm) is decomposed when acted upon by potassium hydrate; amongst the products of decomposition are potassium nitrate, glycerin, ammonia, cyanogen, oxalic, humic, and nitrous acid. When ignited in a vacuum with copper oxide and copper, 2 vols. of carbonic anhydride, and 1 vol. of nitrogen are obtained, from which numbers the formula $C_3H_5(NO_2)_3O$ is deduced. Nitroglycerin dissolves in concentrated sulphuric acid, forming with it a new compound acid which yields crystalline salts. A combustion gave 3 vols. of carbonic anhydride to 1 vol. of nitrogen. If nitroglycerin is regarded as a substituted glycerine, and the relation between it and the new acid the same as that between glycerin-sulphuric acid, and glycerin, the new compound will be dinitroglycerin-sulphuric acid.—(*Oefvers. af Akad., Förh.*, 1868, 25, No. 2, 75, and *Fourn., p. Ch.*, cv., 254.)

OBITUARY.

MR. GEORGE LOWE, F.R.S., the eminent Gas Engineer, died on Christmas Day at his residence at Finchley. He was elected an Associate of the Institution of Civil Engineers in 1823, transferred to the class of members in 1829, and for some years was a most useful member of the Council. His name is connected with many improvements in gas engineering, the most prominent being his system of reciprocating retorts and his motive-power meter.

On January 4th the death of JAMES EDWARD FORBES, D.C.L., LL.D., F.R.S., late Principal of the United Colleges of St. Salvador and St. Leonard's, St. Andrew's, was announced. The deceased, who was a son of the late Sir William Forbes, Bart., of Pitsligo, was born in Edinburgh in 1809, and was educated at the University of Edinburgh, where he obtained several prizes and where he held the professorship of Natural Philosophy from 1833 till 1860. In 1832 he was elected a Fellow of the Royal Society, and received the Rumford and Royal Medals; he also gained the Keith Medal of the Royal Society of Edinburgh, of which society he was Vice-President. He was the author of a number of works on physical science, as well as of works in various departments of general literature, some of the most noted being "Papers on the Theory of Glaciers," "Norway and its Glaciers," and "Travels in the Alps of Savoy."

CORRESPONDENCE.

ON THE FUMING OF CERTAIN ACIDS.

To the Editor of the Chemical News.

SIR,—I was struck by the inquiry of a student in a late number of the CHEMICAL NEWS, why hydrochloric acid fumes when let out into the air, while ammonia, which has a much stronger attraction for water, does not?

If the student continues to read his chemistry with the same inquiring spirit that prompted this question, he will not only become a good observer himself, but he will have an influence in making our text-books better exponents of observation than some of them are, in many respects, at present.

It is not an unusual fault that our books contain too many bald facts often adopted without sufficient verification, and too little reasoning. Facts are good soldiers; theory a good general; but unless they work together, there is very little real fighting.

But to the point. Why does not ammoniacal gas fume when let out into the air?

I took the specific gravity of a solution of ammonia and found it to be 0.889. Twenty-four drachms of this were put into a flask and heated over a spirit lamp. It at once entered into brisk ebullition, and there was a great head of gas bubbles from which very large bubbles expanded and burst. The thermometer rose slowly to 100° F. When the lamp was removed the boiling ceased instantly, but two or three rapid streams of small gas bubbles continued to be discharged for some time from black specks in the glass, which acted as nuclei. When the temperature was at 160° the lamp was removed, and the solution left to cool. It still smelt of ammonia; the lamp was replaced, and no gas bubbles were given off until the temperature had again risen to about 160°. The appearance of ebullition was much less marked than before, and the temperature rose to 208°, at which it became stationary (Barometer, 28.69 inches). When cold, only 10 drachms remained of the 24. The specific gravity was now 0.997. The liquid had a faint smell of ammonia and a slight action on turmeric paper; but on putting the glass into another room, where the liquid could not re-absorb ammonia, it lost, in the course of some hours, all smell; it had no action on turmeric paper; it was, in fact, brought back to pure water.

If a similar experiment be made with a strong solution of hydrochloric acid, it will be found impossible to boil away all or nearly all, the acid gas. If we operate on the acid solution of specific gravity 1.21, it will part with gas until it has a density of 1.10 (at 60°), when it will have a boiling point at 233° F., and will distil unchanged.

We see, then, that although ammoniacal gas and hydrochloric acid gas are greedily absorbed by water, there must be some important differences in the constitution of the respective solutions. We have seen that the alkaline solution is much lighter than its own bulk of water, the acid solution much heavier; that the presence of ammoniacal gas in water lowers its boiling point, while the presence of hydrochloric acid in water has a contrary effect. Hence the mode of combination between ammonia and water must be different from that between hydrochloric acid and water. The one must be a case of simple adhesion, the other of true chemical combination as well as adhesion.

Ammonia let out into moist air, simply adheres to the moisture and increases its volume. Vapour of alcohol, ether, &c., does the same. Now any amount of aqueous vapour that the air can maintain in an invisible elastic state, at a given temperature, it can maintain with increased effect in the case of ammonia vapour, alcohol vapour, &c. Hence the combination of these vapours with the moisture of the air is necessarily an invisible compound.

Hydrochloric acid gas, on the other hand, let out into the air, combines chemically with the moisture, producing condensation or diminution of bulk. Hence the compound is visible just as the condensation of pure steam in air produces visible vapour.

Fuming nitric acid and Nordhausen sulphuric acid are also cases in point. Concentrated nitric acid exposed to the air absorbs moisture until it attains the density of 1.424, when it distils unaltered at a boiling point of 250°.—I am, &c.,

C. TOMLINSON.

Highgate, N., Dec. 28, 1868.

MISCELLANEOUS.

Sale of Poisons Act.—A very important act of Parliament—the Amended Pharmacy Act, or Sale of Poisons Bill—came into operation on the 1st inst. By this act it is directed that on and after the 1st day of January, 1869, no poison shall be sold by any person except those registered according to the acts now in force as pharmaceutical chemists, or chemists and druggists; and that every box, bottle, vessel, or wrapper containing poison shall be distinctly labelled with the name of the article, together with the name and address of the person selling the same. A schedule of poisons is given, divided into two sections. All those in section A are strictly forbidden to be sold to any person not known to the seller, unless introduced by some person known to the seller; a register of the sale is compulsory, and must be attested by the signature of the purchaser and his or her witness; while those poisons included in section B need only to be properly labelled. All medicines must be compounded with articles prepared strictly according to the *British Pharmacopæia*; and every adulteration of any article retailed shall be deemed an admixture injurious to health, punishable under the provisions of the Act for Preventing the Adulteration of Articles of Food or Drink. The poisons defined by this act are—in Part 1, arsenic and its preparations, prussic acid, cyanides of potassium and all metallic cyanides, strychnine and all poisonous vegetable alkaloids and their salts, aconite and its preparations, emetic tartar, corrosive sublimate, cantharides, savin and its oil, ergot of rye and its preparations; and in Part 2, oxalic acid, chloroform, belladonna and its preparations, essential oil of almonds, unless deprived of its prussic acid, opium, and all preparations containing opium or poppies. Among the preparations which, according to this act, will have to be labelled as a poison, we notice paregoric elixir, child's cordial, syrup of poppies, and every other syrup, tincture, or lozenge which shall contain the smallest portion of opium or morphia. The object of this Bill is evidently to prevent ignorant persons from dealing in articles the composition of which they do not understand. It will also serve as a check to the poisoning of children by the administration of such preparations as child's cordial, soothing syrups, &c. The fine for selling these articles without being properly labelled is heavy, as it is also for selling them without being properly licensed.

The Gas Supply of the City.—In the month of July of last year an important act of Parliament was passed for improving the quality of the gas supplied to the City of London by the several City Gas Companies, and also to those parts of the Metropolis supplied by the Chartered Gas Company, whereby the quality of the gas was raised from a standard of twelve candles to fourteen, without increase of charge to the consumer; and with the view of securing the provisions of the act, and enforcing penalties in all cases of default, a chief gas examiner is appointed by the Board of Trade to receive the reports of the daily testings of the gas and to decide all matters of dispute respecting the quality of the gas. It is also the duty of the chief gas examiner to report to the corporation, to the

Metropolitan Board of Works, and to the several companies the quality of the gas supplied during the quarter; and in this capacity, and in accordance with the provisions of the 71st section of the City of London Gas Act, 1868, Dr. Letheby has recently submitted his report to the Corporation of London, from which it appears that since the act came into operation, on the 1st of October last, the gas of the several companies supplying the city has been tested every night at intervals of not less than an hour between the hours of five o'clock and ten o'clock. The results are as follows:—

Illuminating Power in Standard Sperm Candles.

	Maximum.	Minimum.	Average.
City of London Gas Light, and Coke Co.	16.30	13.99	15.13
The Chartered Gas Light, and Coke Co.	16.36	14.13	15.26
The Great Central Gas Consumers Co.	16.64	13.46	14.90

It appears, therefore, that the illuminating power of the gas has ranged from 13.46 candles to 16.64—the average for the quarter being 15.13 candles for the City Company, 15.26 for the Chartered, and 14.90 for the Great Central. The daily returns show that on three occasions only the gas has been below the standard, and these were no doubt due to causes which admit of satisfactory explanation. With regard to the purity of the gas, he reports that the gas of the Chartered and Great Central Companies have always exhibited traces of ammonia, but that the gas of all the companies has been constantly free from sulphuretted hydrogen. The amount of sulphur present in the gas has ranged from 7.9 grains to 26.52 per 100 cubic feet, the proportion of this impurity being as follows:—

Grains of Sulphur per 100 Cubic Feet of Gas.

	Maximum.	Minimum.	Average.
City of London Gas Light, and Coke Co.	22.28	10.64	16.89
The Chartered Gas Light, and Coke Co.	26.52	11.01	21.93
The Great Central Gas Consumers Co.	24.94	7.90	14.24

The smallest amount of sulphur has been in the gas of the Great Central Company, and this is attributed by Dr. Letheby to the excellent system of purification adopted by that company. The proportions of sulphur have been determined by the instrument known as Dr. Letheby's sulphur test, which is that recommended for use by the gas referees appointed under the act. It is extremely desirable that this impurity should be reduced to the smallest quantity, on account of the corrosive action of the products of its combustion.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Comptes Rendus.

October 5, 1868.

CHEVREUL, "Researches on Experimental Methods in Chemistry." CROULLEBOIS, "On the Dispersive Power of Gases and Vapours." DUMAS, "Note on Drechsel's Method of Preparing Oxalic Acid from Carbonic Acid." M. BOUCHERIE, "Note on the Preservation of Wood." A. HOUZEAU, "On Testing Campeachy Wood and other Dye Stuffs." N. ZININ, "Contributions to the Knowledge of the Stilbene Series." HIORTDAHL, "On the Native Alloys of Gold and Silver from the Kongsberg Mine, Norway." A. GAUTIER, "On Isopropylcarbylamine and Isopropylamine." J. NEY, "A New Galvanic Battery."

October 12, 1868.

E. FRANKLAND, "On the Combustion of Hydrogen and Carbonic Oxide in Oxygen under a High Pressure." J. KOLB, "Memoir on Bleaching Fabrics." G. RAYET, "On the Spectrum of the Protuberance observed during the Total Eclipse of the Sun of August 18, 1868, at Malacca." J. CLOUET, "On Chromite of Iron." E. PATERNO, "On the Acetal of Trichlorinated Ethyl, and on the Preparation of Chloral."

October 19, 1868.

DUMAS, "Note on a Decision of the Academy relating to Memoirs on Squaring the Circle, Duplication of the Cube, Trisection of the Angle, and Perpetual Motion." WARREN DE LA RUE and H. MULLER, "On a New Constant Battery." RAPATEL, "Report on the Eclipse of the Sun of August 18, 1868, from Observations taken between

Madras and Calcutta." A. GAUTIER, "On the Oxidation Products of Carbylamines." DE SAINT-MARTIN, "On the Density of Saline Solutions."

Bulletin de l'Académie Imperiale des Sciences de St. Petersburg.
June 4, 1868.

P. KOSTYTSCHIEF and O. MARGGRAF "On the Chemical Composition of the Fossil Sponges of the Apatites of the Cretaceous Beds of Russia." N. ZININ, "Note on Chloro-benzil." DUKE NICHOLAS VON LEUCHTENBERG, "Note on Kotchoubeite, Kämmererite, and Pennine." H. JACOBI, "On the Electro-Deposition of Iron." KLEIN, "On the same subject." O. STRUNE, "On the Spectrum of the Aurora Borealis." A. FAMINTZIN, "On the Action of Light on Cell-division in Spirogyra."

Annales de Chimie et de Physique.

September, 1868.

P. AUDOUIN, "On the Use of Liquid Hydrocarbons for obtaining High Temperatures and for Heating Steam Boilers." A. RENARD, "On the Volumetric Estimation of Zinc." E. BOURGOIN, "On the Part taken by Water in Electrolysis." A. MARTIN, "An Improved Process for Silvering Glass by means of Inverted Sugar." P. SCHUTZENBERGER, "On some Reactions producing Oxychloride of Carbon, and on a New Volatile Platinum Compound." DE LAPPARENT, "Report on Pasteur's Method of Preserving Wine by means of Heat." P. SCHUTZENBERGER, "Memoir on the Colouring Matters extracted from Persian Berries."

Bulletin de la Société Industrielle de Mulhouse.

July, 1868. Supplement.

J. KOLB, "Memoir on Bleaching Fabrics." H. KÖCHLIN, "On some Mordants, other than Alumina and Iron, for Garancine Colours, with especial reference to a new Red (*grenat*) Dye obtained with Chromium." A. SCHEURER-KESTNER and C. MEUNIER, "Researches on the Combustion of Coal." C. KÖCHLIN, "A Process for Extracting the Colouring Matter from Waste Fabrics Dyed with Garancine." M. PARAF-JAVAL, "Note on a Method of Preventing the Injurious Action of Aniline Black on the Copper of Printing Rollers." SCHNEIDER, "On the same subject." MARNAS, "A New Aniline Dye."

NOTES AND QUERIES.

Vitriol Chamber.—What is the best shape for a vitriol chamber, and on what does the yield depend? I wish to know whether a chamber of the shape of a cube would yield as much as a longer and narrower one of the same contents?—G. N.

MEETINGS FOR THE WEEK.

MONDAY, 11th.—Medical, 8,
London Institution, 6.
TUESDAY, 12th.—Royal Institution, 3. Prof. Westmacott, "On Fine Art."
Photographic, 8.
WEDNESDAY, 13th.—Geological, 8,
Microscopical, 8.
THURSDAY, 14th.—Royal Institution, 3. Mr. Rupert Jones, "On Protozoa."
London Institution, 6
Royal, 8½.
Zoological, 8½.
Royal Society Club, 6.
FRIDAY, 15th.—Royal Institution, 8. Prof. Tyndall, "On Chemical Rays and Molecules."
SATURDAY, 16th.—Royal Institution, 3. Professor Odling, F.R.S., "On Hydrogen and its Analogues."

TO CORRESPONDENTS.

Mr. Bassett's communication "On a Mercury Compound of Acetylene," together with those of several other correspondents, are unavoidably postponed till next week.

Querist.—One part of sulphur will dissolve in about 2000 parts of glycerine, and we believe the solution has been proposed as a local application in some affections of the skin.

Oriens asks "whether there is, in the service of the Siamese Government, any opening for a technological chemist experienced in the analysis of soils, ores, furnace products, and drysalteries, and if so, what would be the channel for an applicant to offer his services?" Perhaps some of our correspondents may be able to answer this inquiry.

Communications have been received from W. T. Suffolk; H. Sanders; G. Marrison; J. Dicker; W. Salter; Dr. Letheby; O. Richter; J. Wilson; E. Kopp; L. Cookson (with enclosure); J. Pride (with enclosure); S. R. Muspratt; T. Vosper; A. N. Tate; T. Watts; J. Parnell; Dr. R. Angus Smith; Rivington and Co.; W. Macnamara; J. A. Brand; D. Forbes, F.R.S.; G. Young (with enclosure); D. W. Ladley; J. W. Sugg; and C. K. Jewett, Göttingen (with enclosure).

THE CHEMICAL NEWS.

VOL. XIX. No. 476.

ON THE CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(ADAPTED TO A JUVENILE AUDITORY),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN,
(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, Esq., M.B., F.R.S.

(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE II.

CARBONIC GAS—AIR—OXIDES.

Production of carbonic gas by combustions in air of charcoal, of coal, of wood, of candle, and of gas; also by processes of decay, of fermentation, of germination, and of respiration—Discharge of carbonic gas from earth-fissures and mineral springs—Invariable existence of carbonic gas as a constituent of air—Its proportion in the external air very small—Air a material substance, capable of being felt and of being weighed, or having the properties of extension and gravity—Consequences of the weight of air—Existence of different sorts or kinds of air, as ordinary air, fixed air, phlogistic air, vital air, inflammable air, &c.—Some kinds of liquids miscible, others immiscible with each other; but all kinds of air or gas miscible with each other—Ordinary air a mixture, chiefly of two distinct kinds of air—Absorption of about one-fifth of the bulk of ordinary air by different chemical actions, and especially by the rusting of metals, the burning of combustibles, and the breathing of animals.

I FEAR that in my last lecture I did not address myself sufficiently to those of you for whom this course of lectures is especially intended; that is a fault which I must try to mend upon this occasion. To-day, then, we will have the lecture entirely to ourselves, and disregard those full-grown people who sit upon the hinder benches. Now, as I am only going to talk to *you*, I shall not hesitate to venture upon a little recapitulation; and I wish to call your attention to some of the ground that we went over two days ago. You remember we began with marble. I told you that marble is characterised by certain very well-defined properties. It is not one of those substances which become hot when moistened with water; it will not dissolve in water, but it does dissolve in acids; and when it dissolves, the act of solution is attended by that particular kind of action which is called effervescence or frothing. Now you

will remember that this effervescence really consists in the formation or liberation of a particular kind of air or gas underneath the surface of the water. Here is the solution of the marble in acid going on. You see it is accompanied with an effervescence, and this effervescence consists in the formation of bubbles of air or gas which we are collecting in this tube. Then we spoke of the action of heat upon marble; and you will remember, also, when the marble is heated very strongly—in this tube, for instance—that it gives out a quantity of air, and we find that the air which is given out from marble when subjected to a strong heat is identical with the air given off from marble by the action of acids.

I next proceed to examine the residue; of what does it consist? We find that the residue consists of quick-lime, and that this quick-lime differs from marble in several particulars.

First, unlike marble, directly we moisten it with water it becomes extremely hot; unlike marble, it dissolves in water, and forms the perfectly clear solution called lime-water. Lime dissolves in water, marble does not; and, unlike marble, the lime, when acted upon by acids, does not give off any kind of air or gas. We find, then, that marble, when strongly heated, is resolved into a particular kind of air or gas which we are here collecting, and into a residue of quick-lime capable of being dissolved in water.

Now what will happen if we take some of the gas evolved from the marble by the action of heat, or some of the gas obtained from the action of acids, and pass it through lime-water? Here you see we are separating our marble into quick-lime which remains behind, and this particular kind of air or gas which is being collected. Here, again, is the same kind of air or gas—generated in this case by the action of an acid, instead of by the action of heat—and we pass it through our lime-water, and re-obtain a substance which is no longer soluble in water. This substance is, in fact, the same chemical compound as the marble with which we began. In one apparatus we decompose marble into gas and quick-lime, and in the other apparatus we reform the marble by combining with the quick-lime the gas evolved from marble by the action of acids. But we may also form marble by using the gas evolved under the action of heat. If, instead of collecting the gas produced from the marble by the action of heat, we allow it to bubble up through this lime-water, you see that in this case, also, we reproduce, in a different form, the marble which we are decomposing by heat in the tube.

Now I call this precipitated substance "marble," but, of course, that is not strictly correct. This substance has the same com-

* Reported verbatim, by permission of the Author, for this Journal.

position as marble, but it is not marble itself, because we apply the name "marble," not to a substance which merely has the same chemical composition as marble, but to a substance having certain physical properties. You will remember that, on the last occasion we spoke about this piece of marble, I called your attention to the fact that it was a brittle substance; but this precipitate that we have got is no longer brittle; in fact, though it is the same thing *chemically* as marble, it is not the same thing *mechanically*. It is chemically the same thing as marble, in the same sense that shells are the same thing as marble. Shells, for instance, when they are acted upon by acid, dissolve in it like marble, and give rise also to the phenomenon of effervescence. Here we have a piece of coral dissolving in the acid with effervescence, and giving off exactly the same kind of gas as from marble; so that, although we have hitherto spoken of this gas as being the gas from marble, we might also call it the gas from shell, the gas from coral, the gas from limestone, or even the gas from pearls.

Now for a word or two about lime. Lime differs from marble in the fact that it does not effervesce when acids are added to it, and the reason of this you will very readily see. The gas which is given off by heating marble so as to leave the quicklime, is identical with the gas given off by the action of acids upon marble; and if we first drive off all the gas by heat, of course there is no more gas left in the marble to be driven off when we act upon it by acids. The marble so heated no longer effervesces with acids, because the whole of the air which it contained has been driven off by heat. In this way we learn that marble is a compound of the quicklime with the air or gas which is given off.

I told you that this precipitate was chemically the same as marble, and as such it ought to be dissolved by acids with effervescence, like the original marble. [Some muriatic acid was added to the water containing the precipitate suspended in it.] In this case you see we get a considerable amount of effervescence; there is a distinct frothing on the top of the water from the effervescence which is now taking place. Well, all these substances—shell, coral, pearl, this precipitated chalk, and limestone—are converted into quicklime by heating; and all effervesce with acids, giving off this particular kind of gas.

Now, what is the nature of this air which is given off? In the first place, we have seen that it has the property of rendering lime-water milky; in the next place we shall find that it has the property of extinguishing the flame of ordinary combustibles. To begin with, we will take this particular portion of gas which we first produced, and lower into it a burning rod of wood. You

see the light is immediately extinguished; and not only will the flame of the burning wood be extinguished, but also the flame of burning gas. We introduce a jet of ordinary gas, and it is at once put out; we ascertain, then, that wood and gas are two substances which will not burn in the air evolved from marble. Let us try another substance. We will take this small piece of candle, and observe whether the same thing will happen to it. Our piece of candle burns perfectly well in ordinary air; let us see whether it will burn in the air from marble. We introduce it; the flame at once goes out. From this we learn that ordinary substances, at any rate, will not burn in the gas from marble.

But chemists, as I told you on the last occasion, are acquainted not only with ordinary combustibles, but also with extraordinary combustibles. Zinc, magnesium, sodium, and iron, although not usually regarded as combustibles, are, nevertheless, combustible in the eyes of the chemist; they have the property of burning in the air. Now this particular substance—sodium—not only possesses the property of burning, as ordinary combustibles do, in air, but it has also the property of burning in the gas from marble; and at the end of the last lecture, when heated in the gas from marble, this sodium not only burned with great brilliancy, but it produced a very extraordinary result. Here is the flask in which we performed the experiment, and we found in it a large piece of charcoal. Where did that charcoal come from? It did not come from the sodium, as we know, for this reason: you may treat sodium in all sorts of ways—burn it in the air, or in a variety of gases; but do what you will with it you cannot get any charcoal out by means of it, unless you employ some substance which, like the gas obtained from marble, contains charcoal; and we may not only get charcoal from the gas by means of sodium, but by a variety of other substances, and therefore we are led to the conclusion that the charcoal came from the gas of the marble, and that this gas or air evolved from marble contains charcoal as an essential constituent.

I have hitherto called this gas "air or gas from marble;" I ought to tell you that it was originally called "fixed air," because it is capable of being fixed or absorbed by lime. It is now called "carbonic gas," because it is the air or gas from charcoal or carbon. Marble, then, is a compound of quicklime with carbonic gas, and is called chemically "carbonate of lime."

The next thing to consider is whether, since we can get charcoal out of carbonic gas, we cannot produce carbonic gas from charcoal as well as from marble. First, let me explain to you the method of ascertaining the presence of this gas; the test used for this purpose is lime-water. The carbonic gas forms with the lime-

water an insoluble compound—chalk—and accordingly, when we find that a gas passed through lime-water converts it into the insoluble substance chalk, we know that we are dealing with carbonic gas—the gas containing charcoal. Now let us see whether we can get any of our carbonic gas produced from charcoal. Here is a tube passing into some lime-water; we draw some of the air from this burning charcoal through the tube into the lime-water, and the lime-water, which at first was perfectly clear, becomes converted into a mixture of chalk and water. We convert the lime into chalk, a proof that we are dealing with that particular kind of gas which has the property of rendering lime-water turbid, and thus we know that by burning this charcoal we are converting it into carbonic gas.

Now, carbonic gas is produced not only by the burning of charcoal, but also by the burning of other ordinary combustibles. Here are some bottles, which in the ordinary acceptation of the term are empty; that is to say, they are full of air and nothing else, and would be called empty bottles. We will first hold one of these bottles over an ordinary gas flame, and then pour into the bottle a little lime-water; we shake it up for a minute or two, and you see our lime-water is converted into chalk, and, therefore, we find that ordinary gas also has the property of forming this carbonic gas or fixed air. We will now try another combustible—a piece of wood. We take a piece of wood in the same way, and allow it to burn inside the bottle, and notice whether, under these circumstances, we obtain this carbonic gas. We will add to it some lime-water, and we shall find that our lime-water in this case, as in the other, becomes milky from the formation of chalk, showing that not only charcoal and coal gas, but wood also, when burnt, has the property of producing this particular kind of gas which we obtain from marble. We will now take another combustible. We will take a taper and burn it in the same way in this other empty bottle, and notice whether any carbonic gas or fixed air is produced; we observe that here, also, our clear lime water is converted into a chalky liquid. We find, then, that carbonic gas is thrown into the atmosphere by all ordinary burning bodies—by the burning charcoal, the coal gas, the wood, and by the taper.

Now, are there any other means by which carbonic gas is discharged into the atmosphere? One other is decay. You all know that in the autumn the leaves fall off the trees, and sometimes accumulate till they are up to your ankles, or even higher. I have not any decaying leaves to experiment with, but I have some rotten wood; and I want to show you that by this, and by the rotting of leaves, sawdust, and bodies generally, we get carbonic gas.

Here is a tube in the shape of the letter U, containing some lime-water, and we will suck the air from this tube through the lime-water, and you will see that the rotting wood has the property of giving off this carbonic gas and rendering the lime-water turbid. Decaying leaves and decaying sawdust would do the same.

Another way in which this gas is also discharged into the atmosphere is by breathing. Here we will vary the experiment a little by putting the lime-water into the bottle first. I will shake up the lime-water to show you that there is nothing formed at present; I do not shake it very violently, or it would form a froth which you might mistake for the whitening of the liquid by the formation of chalk. I now breathe into the bottle, and shake up the contents as I did before; and you will observe that the soluble lime is at once converted into chalk.

You see, then, that this gas from chalk or marble is constantly poured into the atmosphere from endless sources—from all burning bodies, from all decaying bodies, and from all breathing animals. Now is there any other source? In various parts of the earth, more particularly in volcanic districts, we find that quantities of this gas issue from the earth with enormous force. Indeed, so great is the quantity, that it is probable that the amount of this fixed air evolved into the atmosphere from fissures in the earth, and from caves, and volcanoes, and sources of that kind, far exceeds that which is discharged into the atmosphere by all the fires, all the decay, and all the breathing animals on the surface of the earth. Now I cannot bring you any of this natural gas bottled up—at least, not very conveniently; but we find that it may be obtained in other ways. The gas which issues from the surface of the earth sometimes comes up in the form of gas; but sometimes we find water saturated with it—and this is the nature of the natural effervescing waters, such as the Seltzer water, which is imported into this country in bottles, and of the Brighton, or artificial Seltzer water, which is made to imitate the natural water. In these waters a large quantity of the gas is condensed, and it is given off from them just as it is evolved from charcoal by burning it. We will put a screw tap into a bottle of Seltzer water, and see whether we can get any carbonic gas evolved. We turn the tap, and collect some of the gas which is given off, and we find that the gas evolved from Seltzer water is identical with the carbonic gas we have been considering. This illustrates one of the many natural sources of this gas.

You will perceive, then, that in consequence of the constant occurrence in nature of the actions which I have mentioned, the air by which we are surrounded must contain carbonic gas, and as a natural consequence, charcoal. The

invisible air by which we are surrounded really contains charcoal in the form of an invisible gas, and you would, perhaps, think that from the existence of so many natural sources of the gas, the proportion of carbonic gas in the air ought to be very large; but in reality it is extremely small—amounting to only half a part in a thousand; in fact, it is rather less than half a part, but I state it broadly that you may remember it. Now, I can give you some illustration of the quantity by means of an experiment. I have here a tube which contains this carbonic gas, and into the tube I put, not lime-water, but milk of lime—a mixture of lime and water, containing more lime than the water can dissolve. We now shake up the tube of gas and then open it under water; we pour in some more of this milk of lime, and we shall be able by repeating this to dissolve the whole of this kind of air, which, you remember, is called fixed air, because lime has the property of fixing it. I close the end of the tube with my thumb, and shake up the lime with the air of the tube, and again open it under water. You see, the water immediately rises to a considerable height in the tube, and if we continue to operate in this way the water will at last rise to the extreme top; this shows that the lime has the property of completely absorbing this gas. Now if we take this other tube, which only contains common air, and treat it in the same way, the quantity of carbonic gas in the ordinary air is so very small that you will not notice any absorption whatever. I close the tube with my thumb, and shake it up as I did the other, and then insert it under the water and open it, and you will observe that there is practically no absorption, or rather the amount of absorption is so small that you cannot notice it. It amounts to only half a part in a thousand.

Nevertheless, I can show you the presence of this gas in the air if I adopt certain means. I will take some lime-water, and introduce it into this tube in front of you. Here is a vessel, termed an aspirator, filled with coloured water; and if I turn the stop-cock, and allow the water to run out, you will observe that, as the water runs out, the air must be sucked through the lime-water to fill its place; and I daresay that by the end of the lecture we shall have drawn through the lime-water a sufficient volume of air to affect it and render it turbid.

The action is here going on in another way. In this dish I have placed some lime-water, which was originally perfectly clear and brilliant. If you look at it after the lecture you will see that it will be covered with a scum of chalk, due to the carbonic gas in the air of the room. In this way we find that carbonic gas, and consequently charcoal, is a constant constituent of atmospheric air.

(To be continued).

NOTE ON

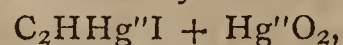
A MERCURY-COMPOUND OF ACETYLENE.

By H. BASSETT.

On passing a stream of coal-gas through the solution known as Nessler's ammonia-test, *i.e.*, a solution of mercuric iodide in iodide of potassium and caustic potash, a considerable quantity of a bright yellow precipitate is obtained. This precipitate is only formed in presence of free potash. After drying, it explodes slightly on heating, giving a sublimate of mercury and iodide of mercury, and leaving a carbonaceous residue. On warming with dilute hydrochloric acid, an inflammable gas is given off, having the characteristic smell of acetylene, and giving, with ammoniacal cuprous chloride, the well-known red precipitate.

The experiment was modified as follows:—A large Bunsen burner was lighted at the bottom, and the supply of air partly cut off; the products of combustion were drawn by an aspirator through a washing-bottle of water, and then through the mercurial solution. This method gave a precipitate of a pale yellowish colour, which exploded rather more violently than the above, resembling in appearance that which was found to be produced by pure acetylene (from the copper compound).

On analysis, this substance gave 70.24 per cent mercury and 23.5 per cent iodine. These numbers may be considered to indicate sufficiently the formula—



which requires 70.42 and 23.36 respectively.

The different appearance of the precipitate produced by coal-gas appears to be owing to the presence of other hydrocarbons. In fact, crude benzene gave a bright yellow precipitate, as also did purified oil of turpentine. No precipitate was produced by ethylene or pure benzene. In the case of turpentine, the action seems to consist in a reduction of the mercuric salts with formation of mercurioso-mercuric iodide, of which the precipitate is mainly composed, with only a trace of organic matter.

SPECTROSCOPIC OBSERVATIONS OF THE SUN.

No. II.*

By J. N. LOCKYER.

THE author, after referring to his ineffectual attempts since 1866 to observe the spectrum of the prominences with an instrument of small dispersive powers, gave an account of the delays which had impeded the construction of a larger one (the funds for which were supplied by the Government-Grant Committee early in 1867), in order that the coincidence in time between his results and those obtained by the Indian observers might not be misinterpreted.

Details are given of the observations made by the new instrument, which was received incomplete on the 16th of October. These observations include the discovery and exact determination of the lines of the prominence spectrum on the 20th of October, and of the fact that the prominences are merely local aggregations of a medium which entirely envelopes the sun. The term chromosphere is suggested for this envelope, in order to distinguish it from the cool absorbing atmosphere on the one hand, and from the white light-giving photosphere on the other. The possibility of variations in the thickness of this envelope is suggested, and the phenomena presented by the star in Corona are referred to.

It is stated that, under proper instrumental and atmospheric conditions, the spectrum of the chromosphere is always visible in every part of the sun's periphery; its

* Abstract from the *Proceedings of the Royal Society*, No. 106, 1868.

height, and the dimensions and shapes of several prominences, observed at different times, are given in the paper. One prominence, 3' high, was observed on the 20th of October.

Two of the lines correspond with Fraunhofer's c and f; another lies 8° or 9° (of Kirchhoff's scale) from d towards e. There is another bright line, which occasionally makes its appearance near c, but slightly less refrangible than that line. It is remarked that the line near d has no corresponding line ordinarily visible in the solar spectrum. The author has been led by his observations to ascribe great variation of brilliancy to the lines. On the 5th of November a prominence was observed in which the action was evidently very intense; and on this occasion the light and colour of the line at f were most vivid. This was not observed all along the line visible in the field of view of the instrument, but only at certain parts of the line which appeared to widen out.

The author points out that the line f invariably expands (that the band of light gets wider and wider) as the sun is approached, and that the c line and the d line do not; and he enlarges upon the importance of this fact, taken in connection with the researches of Plücker, Hittorf, and Frankland on the spectrum of hydrogen—stating at the same time that he is engaged in researches on gaseous spectra which, it is possible, will enable us to determine the temperature and pressure at the surfaces of the chromosphere, and to give a full explanation of the various colours of the prominences which have been observed at different times.

The paper also refers to certain bright regions in the solar spectrum itself.

Evidence is adduced to show that possibly a chromosphere is, under certain conditions, a regular part of star-economy, and the outburst of the star in Corona is especially dwelt upon.

ON THE ACTION OF SUNLIGHT ON BISULPHIDE OF CARBON.

By O. LOEW,
Chemical Assistant in the College of the City of New York.

PURE bisulphide of carbon, when exposed to the sunlight for a considerable time, becomes somewhat yellow. To study the changes thus produced, a large quantity of the bisulphide was enclosed in sealed tubes and exposed to the action of the sun. Decomposition took place gradually, and a brown insoluble substance was formed, which adhered so closely to the inner surface of the tubes that it could not be detached by vigorous shaking. This substance prevented the further action of the sun's rays, and consequently the decomposition ceased.

If water be present in the tubes, this adherence is prevented, and a larger quantity of the brown substance is obtained. After an exposure of two or three months the tubes were opened. The water was slightly acid in its reaction, and, after being neutralised and concentrated, it showed a distinct reducing power upon salts of silver and mercury. Evidently, therefore, a trace of formic acid was produced, according to the following equation:—



On filtration, the newly-formed brown compound remained on the filter, while the filtrate contained free sulphur dissolved in the bisulphide of carbon. On examination, this compound corresponded in every particular to the sesquisulphide of carbon, the substance discovered by me two years ago. It was insoluble in water, alcohol, ether, chloroform, bisulphide of carbon, and oils,

* C = 12; O = 16; S = 32, &c.

but soluble with decomposition in a boiling solution of caustic potash. On heating it in a glass tube, it was directly separated into its components; the sulphur volatilised and the carbon remained.

If sulphocarbonate of potash in concentrated solution be exposed to the sunlight, the decomposition is so slight as hardly to be noticed; when the solution is treated with sodium amalgam, however, a reduction to lower sulphides takes place.

In view of the fact that direct sunlight reduces free bisulphide of carbon, it might be supposed that the corresponding body, carbonic acid, would, in presence of water, be reduced in a similar manner; all my experiments in this direction, however, have thus far been unsuccessful. Nevertheless, since this reduction takes place very readily in the tissues of plants under the influence of sunlight, I am not without hope that this process will yet be imitated in the laboratory.—*American Journal of Science*, November, 1868.

ON THE ALLEGED POISONOUS QUALITY OF BEEF-TEA AND EXTRACT OF MEAT. By BARON LIEBIG.

ALTHOUGH it is contrary to common sense to believe that the daily food of men and animals could possibly contain a substance injurious to health, it was nevertheless to be expected that the experiments made by Dr. Kemmerich on the effect of beef-tea and its salts on animals would produce anxiety and fear in some weak minds; and, indeed, the article which appeared in *Once a Week*, entitled, "A Word of Warning to Cooks," is a proof that such fears really existed. I believe, however, that a simple acquaintance with the experiments of Dr. Kemmerich will be sufficient to dispel them completely. The results of these experiments are of a very harmless character. Dr. Kemmerich made most of his experiments, not upon men, but upon graminivorous animals, viz., upon rabbits, and only one experiment was made by him upon a dog. The broth was made from horseflesh, and injected into the stomach of the animals in progressively augmented quantities, the chief results of which are as follows:—

A rabbit weighing not quite two pounds, which had received the broth from one pound of horseflesh (equivalent to half an ounce of extract), remained perfectly well. It polished itself with its paws, was very lively, and no disturbance in the state of its health was afterwards perceptible.

A second rabbit of two pounds weight, into the stomach of which the extract of one pound and a quarter of horseflesh had been introduced, departed itself in just the same manner; its pulse became more vigorous, its breathing slower, and it remained lively and healthy.

When, however, the doses were increased, and the extract of two pounds and of two pounds and a quarter of flesh were injected into the stomach of the rabbit, such quantities of concentrated animal food were evidently too much for the little graminivorous creature, which by such doses Dr. Kemmerich succeeded in killing, a result at which nobody will be surprised. It follows that Dr. Kemmerich could likewise have killed stronger animals with beef-tea; and it may be assumed that he would have killed even a man of 140 lbs. weight (seventy times heavier than a rabbit) by a dose of beef-tea seventy times as large,—namely, by the broth of 140 lbs. of flesh, equivalent to about 4 lbs. of extract of meat. Less than a couple of pounds of extract would, however, scarcely have been sufficient, for one of the experiments of Dr. Kemmerich on a carnivorous animal contrasted with the experiments on the rabbits; he did not succeed in poisoning that animal with beef-tea.

It was a small but very strong terrier which had taken the broth of four pounds of flesh (equivalent to two ounces of extract), which the animal seemed to enjoy considerably. As, however, the whole quantity was too much for it, it became necessary to inject the remainder into its stomach. Notwithstanding the enormous quantity of extract of meat which had been introduced by force, the terrier remained very comfortable and lively, and no symptom of any disturbance of its health became manifest. Double the of meat-broth which killed the rabbit had not the least injurious effect on the little dog.

These experiments and the above calculations show sufficiently what is to be thought of the poisonous effect of beef-tea; it belongs to the category of cases where people have eaten *pâté de foie gras*, turtle soup, or oysters to such excess as to cause death; but no sensible person will ever dream of ascribing, on that ground, poisonous qualities to *pâté de foie gras*, turtle soup, or oysters.

The experiments of Dr. Kemmerich are described in his "Dissertatio Inauguralis," for obtaining the degree of Doctor from the medical faculty at Bonn; and in his connecting with his conclusions the meaning of the word "poison" he, in fact, succeeded in drawing to his work the attention of the public, which otherwise would probably have taken little notice of it.

Dr. Kemmerich ascribes the effect of beef-tea not to its aromatic and combustible ingredients, but to the potash salts which it contains, and of which it is well known that in larger doses they exercise an injurious effect on the organism; nevertheless, and this is a matter of great importance, potash salts are an element of all articles of food; they not only form the chief ingredients of the salts of all sorts of flesh, including the flesh of fish, but likewise of all other food, and of all the food of animals. The alkaline salts of bread, vegetables, and hay consist of potash salts, and, with the exception of chloride of sodium (kitchen salt), soda salts are but rarely contained therein; in fact, it may safely be asserted that without the potash salts our food would be quite unfit for nourishment.

It does not follow, therefore, that these salts, when taken in excess, like any other—even the most harmless substance—might not eventually exercise an injurious effect. It is however, preposterous to apply the meaning which we are accustomed to attach to the word "poison" to the effects of such an excess. It is surely quite absurd to connect this meaning with substances which we daily take in our food, and which are quite indispensable to our existence.

Dr. Kemmerich himself says (p. 31), "I do not think of the possibility that beef-tea, in the form in which it is used for household purposes, could be the cause of poisoning; it therefore does not require a medical warning to protect from poisoning with Liebig's extract of meat." He further says, "In medical practice, wine, ether, camphor and musk are eminent analeptica (invigorating and refreshing remedies). Compared to these giants of medicine beef-tea modestly occupies a subordinate position. If however, it be necessary to preserve the exhausted body from protracted illness, then there is no other remedy in the whole rich store of medicine which can afford such assistance for regenerating the diseased organism as repeated doses of beef-tea."

One of the three theses defended by Dr. Kemmerich, on his promotion before the medical faculty at Bonn, is worthy of observation by the British navy. It runs thus:—

Thesis 2. "The best remedy against scurvy is beef-tea, or Liebig's extract of meat."—*Pharmaceutical Journal*.

Preparation of Nitrogen.—A new and elegant method of preparing nitrogen gas has been devised by an Italian chemist, M. Massino Levy. It consists in heating bichromate of ammonia in a retort. The salt is transformed into green sesquioxide of chromium, and disengages vapour of water and nitrogen.—*Cosmos*.

ON FOOD.*

By DR. LETHEBY, M.A., M.B., &c.

(Continued from vol. xviii., p. 281.)

Preservation of Food—Unwholesome and Adulterated Food.

I COME now to the last division of our subject—viz., that which relates to the sale and use of unsound and adulterated food; and perhaps the most important of this kind of food is bad meat—that is, meat which is unwholesome on account of putridity or disease. Food of this description has always been a subject of legal prohibition. Among the Jews the prohibition dates from the time of Moses, who is supposed to have received from the Lord, during his sojourn upon Mount Sinai, certain oral commandments respecting the slaughtering of animals for food and the examination of their bodies for disease. There is no account of these commandments in the written law, but they were evidently communicated to the people of Israel by Moses, for he says, "Thou shalt kill of thy herd, and of thy flock, which the Lord hath given thee, as I have commanded thee."—(Deut., chap. xii., v. 21.) It is presumed, therefore, that these instructions were very specific, and they have been practised by the Jews from that time until now. The Hebrew law is, that no flesh shall be eaten, except of animals that have been killed and searched, or examined, by the officer (*bodek*) appointed for that purpose; and the most precise rules are laid down for his guidance in these matters. In fact he is bound by very solemn obligations to declare of every animal that he kills whether the flesh is proper to be eaten (*caser*), or is unfit for food, by reason of its being diseased or torn (*trefa*). This expression appears to have been derived from an ordinance of Moses, that no flesh should be eaten that is torn in the field (Exodus, chap. xxii., v. 31); the word torn (*trefa* or *terefa*) being supposed, according to the traditions of Hebrew sages, to apply not only to animals torn in the chase, or by wild beasts, or by the bungling act of the butcher, but also to those affected with any disease that would shorten their lives; and as it is thought that such disease is always indicated by the condition of the lungs, the utmost care is taken by the searcher or *bodek* in the examination of these organs. His rules or instructions for this purpose are very strict; but generally it may be said that he condemns as unlawful, or unfit for food, the flesh of all animals in which the lungs present the following appearances:—Certain deficiencies, excess, or displacement of the lobes; adhesions, or false membranes; tubercles, or abscesses containing matter or opaque water; discolourations which do not disappear when the lungs are inflated; ulcers, holes, and abrasions letting air through them; consolidations that are impervious to air, and rottenness of tissue. Many of these are, no doubt, unimportant evidences of disease, and, therefore, although the flesh of such animals is rejected by the Jew, it is freely consumed by the Christian. The Jews, indeed, make a sort of bargain with the unorthodox butcher, to take only such animals, when slaughtered by their officer, the *bodek*, as he considers lawful, and the rest are sold to the public. I dare say this has been the practice at all times, for there are frequent references to it in our legal and domestic records. In *Liber albus*, for example, there is a memorandum to the effect that on the 24th of June, 1274, certain discreet men of the city were summoned before the king's council, to answer the question as to what was done with the unclean flesh of the Jews, and whether it was lawful for Christians to buy and eat the same. Their answer was, that if any citizen bought such flesh of a Jew, he would be expelled, and if convicted by the sheriff he would forfeit

* The Cantor Lectures, delivered before the Society of Arts.

such flesh, which would be given to lepers or dogs, and he, in addition, would be heavily fined. To which the council replied that they commanded them, in the king's name, to have the custom strictly observed. I fear, however, from the legal records of *Liber albus*, that less attention was paid in those days to the sale of diseased meat than to that of putrid meat; for, on examining the accounts of the citizens made and rendered in divers courts of the king, I find that while "judgment of pillory" is recorded in twenty-one cases for selling putrid meat, poultry, or fish, there is not a single instance of a like punishment for selling the unclean meat of the Jews.

In ancient Rome there were overseers appointed to examine the meat in the public markets before it was sold, and butchers were often fined for neglecting the law in this respect. Mr. Charles Reed has given us an example of this from the *Acta Diurna*, or Roman Gazette, of 585 years after the building of Rome, which, when translated, runs thus: A.U.C. DLXXXV., Fourth of the kalends of April. The fasces, with Licinius, the consul, and Lertinus, ædile, fined the butchers for selling meat which had not been inspected by the overseers of the markets. The fine is to be employed towards building a chapel to the temple of the goddess Tellus.

In modern times, also, severe regulations have been made in all the states of Europe for the government of this matter, and in many cases particular instructions are given as to the kind of disease which renders meat unfit for human food—it being the practice to examine the animal while alive, and its carcass when dead. This examination is entrusted to properly-qualified officers, who are bound to condemn diseased and putrid meat, as well as the flesh of animals that have died otherwise than by the hand of the butcher, and no meat can be sold until it has undergone such an examination. In this country, however, although there are laws prohibiting the sale of unsound and unwholesome food, yet there is no provision for the systematic inspection of meat, even when it has reached the public shambles. All that the law declares is that the local authority may, if it pleases, appoint an officer for that purpose; and as the appointment would cost money, and is not compulsory, it is rarely made. Practically, therefore, there is, except in a few places, an almost unchecked traffic in diseased and unwholesome meat, and the worst descriptions of it are generally sold to the poor at night.

Our forefathers made stringent rules to prevent this; for, among other things, they ordained "that butchers shall close their shops before candle-light, and shall not sell flesh meat by light of candle."—(*Liber albus*.)

Within the City of London the inspection is performed as carefully as it can be, but, nevertheless, amidst the confusion of business in the early hours of morning, a great deal of unsound meat escapes the notice of the inspectors. In fact, if it were not for the assistance afforded to them by the salesmen of the markets, it would be absolutely impossible to check, to any large extent, the sale of unwholesome meat; for in the three markets of the city—Newgate, Aldgate, and Leadenhall, as much as 400 tons of meat are sold daily. It is brought from all parts of Great Britain and Ireland, as well as from Belgium, Holland, and France, and even from the ports of the Baltic. Of this a large quantity is diseased, and it comes chiefly from our own country towns, where it is a common practice to forward to London everything that is unsaleable at home. I cannot tell what is the actual proportion of bad meat to good, but we seize and condemn about two tons a week, and this is in the proportion of one part to 750. Last year the amount of meat condemned as unfit for food was nearly 129 tons, and in the preceding year it was more than 152 tons. In fact, during the seven years which have expired since the inspectors were appointed under my recommendation, we have seized and destroyed 1,567,810 lbs., or just 700 tons of meat as unfit for human food. Of this quantity, 805,653 lbs. were

diseased, 568,375 lbs. were putrid, and 193,782 lbs. were from animals that had not been slaughtered, but had died from accident or disease. It consisted of 6,640 sheep and lambs, 1,025 calves, 2,896 pigs, 9,104 quarters of beef, and 21,976 joints of meat; besides which there were also seized and condemned in the city markets, on account of putridity, 19,040 head of game and poultry, 207 quarters of venison, and above 7,000,000 of fish, together with thousands of bushels of whelks, shrimps, periwinkles, &c.

It is to be regretted that in the various Acts of Parliament which relate to the condemnation of unsound meat, there are no special rules for the guidance of the officers appointed to investigate this matter—there being only a very loosely-worded general provision to the effect that the medical officer of health, or the inspector of slaughter-houses, or the inspector of nuisances, may, at all reasonable times, inspect and examine any animal, carcass, meat, poultry, game, flesh, fish, &c., exposed for sale, or deposited in any place for the purpose of sale, or in preparation for sale, or intended for the food of man; and in case it appears to the medical officer of health, or the inspector, to be diseased, or unsound, or unwholesome, or unfit for the food of man, it shall be lawful for him to seize the same, and for a justice to order it to be destroyed. In this regulation there is no particular reference to the kind of food which is unwholesome, or to the circumstances which render it so, and therefore much is left to the discretion of the officer who examines it. In the city of London the practice is to condemn the flesh of animals infected with certain parasites, as measles, flukes, &c.; and of animals suffering from fever or acute inflammatory affections, as rinderpest, pleuro-pneumonia, and the fever of parturition, and of animals emaciated by lingering disease, and those which have died from accident or from natural causes, as well as all meat tainted with physic, or in a high state of putrefaction. A little practice is required to distinguish meat of this description, but generally it may be said that good meat has the following characters:—

1st. It is neither of a pale pink colour nor of a deep purple tint, for the former is a sign of disease, and the latter indicates that the animal has not been slaughtered, but has died with the blood in it, or has suffered from acute fever.

2nd. It has a marbled appearance from the ramifications of little veins of fat among the muscles.

3rd. It should be firm and elastic to the touch, and should scarcely moisten the fingers—bad meat being wet, and sodden, and flabby, with the fat looking like jelly or wet parchment.

4th. It should have little or no odour, and the odour should not be disagreeable, for diseased meat has a sickly cadaverous smell, and sometimes a smell of physic. This is very discoverable when the meat is chopped up and drenched with warm water.

5th. It should not shrink or waste much in cooking.

6th. It should not run to water or become very wet on standing for a day or so, but should, on the contrary, dry upon the surface.

7th. When dried at a temperature of 212° or thereabout, it should not lose more than from 70 to 74 per cent of its weight, whereas bad meat will often lose as much as 80 per cent.

Other properties of a more refined character will also serve for the recognition of bad meat, as that the juice of the flesh is alkaline or neutral to test-paper, instead of being distinctly acid; and the muscular fibre, when examined under the microscope, is found to be sodden and ill-defined.

The signs of parasitic diseases are not always observable without careful examination. In the case of the fluke in the livers of sheep, and of measles in pork, and of hydatids in the brain or liver, the nature of the disease is at once

discoverable, but it is not so with the smaller measles or *cysticerci* of beef and veal, and it is still less so with the *trichina* of pork—the microscope being required to reveal their presence.

And here, perhaps, we may ask, what are the effects of diseased or putrid meat on the human system? The question is undoubtedly very difficult to answer, for while, on the one hand, we have abundant evidence that such meat may frequently be eaten with impunity, so on the other we have many remarkable instances of injury occasioned by it. In Scotland there is a disease called braxy, which attacks the sheep and lambs in spring and early summer. It is the cause of at least half the deaths in the flock during the year. The disease kills the animals very quickly by causing stagnation of blood in the most important vital organs; and as the carcass is the perquisite of the herdsman, he most invariably eats it—taking the precaution to remove the offal, and to cut away the darker portions of the flesh where the blood has stagnated. He also salts it before he uses it; and if questioned on the subject he will tell you that the meat is not unwholesome. Every now and then, however, when perhaps the diseased parts have not been entirely removed, or when the salting has not been sufficiently prolonged, or the cooking has not been thoroughly effected, the most serious consequences result from it, insomuch that many medical practitioners who are acquainted with the habits of the Scotch shepherds in this respect, and have seen the mischief occasioned by the meat, declare that braxy mutton is a highly dangerous food for man. Again, it is a common practice with farm-labourers to eat the flesh of sheep affected with staggers, which is a parasitic disease of the brain; and even of animals dying from acute inflammatory diseases. There is a story told on the authority of Dr. Brücke, the professor of physiology in Vienna, that some years ago, when the steppe-murrain was prevalent in Bohemia, and the infected animals were killed and buried by order of the government, the poor people dug up the carcasses of the dead bullocks, and cooked them, and ate them without injury. In this country also, during the prevalence of rinderpest in 1863, enormous quantities of meat from the diseased animals were sent to market, and sold and eaten. The same has been the case with the carcasses of animals suffering acute pleuro-pneumonia; and if, as Professor Gamgee says, the practice of making salvage out of diseased animals is so common that at least one-fifth of the meat which is sold in the public markets is diseased, we may well ask, in the words of Mr. Simon, how it is that some sort of pestilence is not bearing witness to the fact? How is it that cattle having all the foulness of fever in their blood, or having local sores and infiltrations, that yield one of the deadliest of inoculable morbid poisons, or having their flesh thronged with larval parasites, do not, when slaughtered and eaten, produce a general poisoning? Parent Du Chatelet has commented in very forcible language on the apparent immunity from disease even when the most foul and loathsome of animal foods are eaten. But is it not possible that the danger is averted by the operation of cooking? Not that the human stomach has not also a wonderful protective power in its own natural functions; for the deadly poison of the cobra or the rattle-snake may be swallowed with impunity. It is possible, however, that these safeguards may fail us occasionally, and then it is perhaps that the most serious consequences arise. I have often had to investigate cases of mysterious disease which had undoubtedly been caused by unsound meat. One of these, of more than ordinary interest, occurred in the month of November, 1860. The history of it is this:—A fore-quarter of cow-beef was purchased in Newgate market by a sausage-maker who lived at Kingsland, and who immediately converted it into sausage meat. Sixty-six persons were known to have eaten of that meat, and sixty-four of them were attacked with sickness, diarrhoea, and great prostration of vital powers. One of them died; and at the request of

the coroner, I made a searching inquiry into the matter, and I ascertained that the meat was diseased, and that it, and it alone, had been the cause of all the mischief. Dr. Livingstone tells us that when the flesh of animals affected with pleuro-pneumonia is eaten in South Africa, by either natives or Europeans, it invariably produces malignant carbuncle. He says, indeed, that the effects of the poison were often experienced by the missionaries who had eaten the meat, even when the presence of the disease was scarcely perceptible; and in many cases when the Backwains persisted in devouring the flesh of such diseased animals, death was the consequence. The virus, he says, is neither destroyed by boiling nor by roasting, and of this fact he had innumerable instances. Now, it is a remarkable circumstance that ever since the importation of this disease (pleuro-pneumonia) into England from Holland in 1842, the annual number of deaths from carbuncle, phlegmon, and boils, has been gradually increasing. In the five years preceding that time the mortality in England from carbuncle was scarcely 1 in 10,000 of the deaths; from 1842 to 1846 there is no record of the disease; but in the next five years, from 1846 to 1851, the mortality rose to 2.6 per 10,000 of the deaths; and in the next five years it amounted to 6.2 per 10,000; and in the succeeding five years to 5.4. In the case of phlegmons, the increase in the mortality is still more remarkable, for it rose from an average of 2.5 per 10,000 of the deaths in the five years preceding the importation of the disease, to 81 per 10,000 in the ten years from 1847 to 1856. The Registrar-General of Scotland has directed public attention to this fact, saying that deaths from carbuncle are on the increase, and that the mortality from it has been getting larger and larger ever since the lung disease of cattle was imported into Scotland. This accords with the experience of medical practice; but as it is very difficult to trace the immediate connection of bad food with subsequent disease, there being so many circumstances to weaken the connection, it is not surprising that differences of opinion should exist as to the morbid effects of unsound meat; nothing, in short, but an experimental inquiry into the subject, as has already been done in Germany in the case of parasitic diseases, will bring the question to rest; and I see no reason why such an investigation should not be made on the persons of those who send diseased meat to the public market for sale; for as the common defence of their conduct is, that the meat is good for food, they cannot surely object to the penalty of being made to eat it. Here, for example, is a specimen of pork covered with pustules of small-pox; it was seized by one of the city officers on the road to a notorious sausage-maker, and it may, notwithstanding its disgusting appearance, be good and wholesome food; then why not put the question to the proof by making the vendor of it eat it? In the year 1862, when small-pox was prevalent among the sheep in several parts of England, it was a common practice to send the carcasses of diseased animals to the London markets for sale as human food. Later still, in 1863, there was an epidemic of what seemed to be scarlet fever among the pigs of this metropolis, and their carcasses, with all the bright crimson look of the disease, were invariably sent to market for sale as food. Since then the London pigs have been the subject of a virulent spotted fever, of the nature of typhus, and these also have been killed in the last stage of the disease, and sold for food. Abundant illustrations of this kind are constantly coming under my notice, and I feel that the question of the fitness of such meat for food is in such an unsettled state that my action in the matter is often very uncertain, and I should like to have the question experimentally determined; for, as it now stands, we are either condemning large quantities of meat which may be eaten with safety, and are, therefore, confiscating property, and lessening the supply of food, or we are permitting unwholesome meat to pass almost unchallenged in the public markets.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, December 15th, 1868.

E. W. BINNEY, F.R.S., F.G.S., Vice-President, in the Chair.

"Researches on Di-Methyl," Part II., by WILLIAM H. DARLING, Dalton Scholar in the Laboratory of Owen's College. Communicated by Prof. H. E. Roscoe, Ph.D., F.R.S.

In a communication made to the Society in April last I showed that ethyl chloride was obtained by treating with chlorine the gas di-methyl obtained by electrolysis, and that from this substance ethyl alcohol was prepared.

In continuation of that paper I beg to lay before the Society the results of the examination of the properties of the di-methyl obtained by two other processes; first by that of Schützenberger, and finally by that proposed by Frankland.

The former process consists in treating acetic anhydride with peroxide of barium, when the two gases di-methyl and carbonic acid are said to be given off; in the latter process the action of zinc on methyl iodide in sealed tubes heated to about 150° C. yields di-methyl.

These two methods were tried for the preparation of di-methyl, but were abandoned for the electrolysis method for reasons which will be noticed further on.

1. *Preparation of Di-Methyl by Schützenberger's Process.*—When peroxide of barium acts on acetic anhydride, a gas stated to be di-methyl is given off.

If the peroxide is heated with the anhydride, as Schützenberger directs, violent explosions occur. This can be avoided by mixing the peroxide with dry sand, provided the flask containing the mixture is not cooled; if it is cooled, the reaction after a time becomes so violent, probably owing to the formation of peroxide of acetyl, that explosions occur.

20 grms. of peroxide of barium mixed with 40 grms. of dry sand were poured into a flask containing 20 grms. of acetic anhydride and mixed by shaking; the gas evolved was collected in a Pepy's gas holder, and afterwards displaced by pressure, purified by passing through a solution of caustic potash and afterwards through concentrated sulphuric acid. The treatment with chlorine, exposure to the sun's light, and final displacement, was effected in the method described in the previous paper.

The total volume of liquid obtained from acetic anhydride prepared from one pound of phosphorus did not exceed 25 c.c., and began to boil at 40° C., the temperature rising up to 80° C. This quantity proved too small to admit of being fractionated, in order to separate any more highly chlorinated products.

In order to ascertain the cause of so small a yield of chloride, the gas was analysed, according to Bunsen's method, and proved to be a mixture of carbonic oxide, marsh gas, di-methyl, with a small amount of olefines, the following being the result :—

Carbonic oxide	..	..	..	..	..	4.29
Olefines	..	..	..	..	..	0.63
C ₂ H ₆	..	..	..	..	..	18.57
CH ₄	..	..	..	..	..	76.51
						100.00

This analysis clearly shows that Schützenberger's description of the decomposition is incorrect, the greater part of the gas consisting of hydride of methyl or marsh gas.

2. *Preparation of Di-methyl by Frankland's Method.*—Schützenberger's method not giving the required gas, this process was tried. I took advantage of the directions given by Schöyen for the preparation of pure di-ethyl.

Into stout glass tubes closed at one end, metallic zinc, made rough on its surface, was introduced; the open end was then softened before the blowpipe, thickened, and drawn out into a strong capillary, which was bent twice at right angles, as described by Frankland. Through this the methyl iodide was introduced, and afterwards the ether, equal in volume to that of the iodide. The air was expelled by boiling the ether and closing the capillary.

Tubes thus prepared were heated to 130° C., until all the zinc was dissolved, then opened before the blowpipe when cold, to allow any marsh gas to escape which had been formed by the presence of moisture, again closed and heated to 150° C. for several hours. The tubes when cold were then immersed in a mixture of salt and ice: the end of a narrow tube of thick caoutchouc drawn over the capillary, the other end being attached to a gas-holder containing a saturated solution of common salt, and the end of the capillary was then broken off. The gas rushed into the holder, the internal pressure frequently projecting some of the liquid contents of the tube into the gas-holder, where in contact with the water, decomposition took place with the formation of marsh gas, it being impossible to decompose all the zinc-methyl.

The di-methyl thus obtained on treatment with chlorine &c., yielded a small quantity of a liquid which began to boil at 11° C., and rose above 80° C. The quantity was however, but small, in consequence, no doubt, of the presence of marsh gas derived from the zinc-methyl, which was carried over by the pressure of the gas in the tubes; and as it became apparent that considerable difficulty would be encountered in preparing large quantities of the pure gas by this method, it was abandoned.

An analysis of this gas, according to Bunsen's method, shows that pure di-methyl is to be obtained by this method—

	Found.	Calculated for Di-methyl.
Gas employed	.. .. 16.71	.. ..
Contraction	.. .. 42.30	.. .. 41.77
Carbonate acid	.. .. 33.50	.. .. 33.42

I cannot conclude this communication without expressing my thanks to Professor Roscoe and Mr. Schorlemmer for the very able assistance rendered to me throughout this research.

"On a Property of the Electric Current to Control and Render Synchronous the Rotations of the Armatures of a number of Electro-Magnetic Induction Machines;" Illustrated by Working Models; by Henry Wilde, Esq.

FOREIGN SCIENCE.

PARIS, Jan. 13, 1869.

Reagent for Alkaloids.—Purification of Bisulphide of Carbon.—Detection of Strychnine.—Crystallisation of Glycerine.—Detection of Mercury in Poisoning Cases. ACADEMY OF SCIENCES: Native Arseniate of Zinc.—Election of M. Jamin.

THE double iodide of cadmium and potassium has been proposed as a reagent for alkaloids by M. Marmé.

This compound precipitates the following alkaloids from very dilute solutions mixed with sulphuric acid:—Nicotine, conicine, piperine, morphia, codeia, thebaine, narcotine, narceine, quinine, quinidine, cinchonine, strychnine, brucine, veratrine, berberine, atropine, aconitine, and some others. The precipitates are white and flocculent, but for the most part become crystalline. Quinine and strychnine, diluted with 10,000 parts of water, are entirely precipitated. These precipitates are insoluble in ether, soluble in alcohol, slightly soluble in water, and soluble in an excess of the double iodide. By agitation with a

suitable solvent and the subsequent addition of alkali, the alkaloids may be separated. The double iodide of cadmium and potassium does not precipitate glycosides (amygdaline, salicine, saponine, digitaline, phloridzine, &c.).

M. Millon publishes a note "On the Purification of Bisulphide of Carbon." The sulphide of carbon is first washed several times with distilled water, as in the purification of ether, and then transferred to a retort of large capacity containing quick lime. After twenty-four hours' contact the sulphide is distilled off from the lime and received in a flask partially filled with copper turnings, previously roasted to remove all traces of fatty matter, and afterwards reduced by hydrogen. The lime remaining in the retort is strongly coloured. All the disagreeable odour of ordinary bisulphide of carbon is removed by this treatment, and when the nose is placed close to the mouth of the receiver an ethereal odour is only perceived. With bisulphide of carbon thus purified MM. Millon and Commaille have separated the perfume of the most delicate flowers, and even the perfume of milk to the extent of recognising certain plants eaten by the cow, the *Smyrniolum* among others.

To detect the presence of strychnine in cases of poisoning, M. Cloetta counsels the following treatment:—Any albumen which may be present in the liquid is first removed, sub-acetate of lead added, and the liquid filtered; the excess of lead is removed by sulphuretted hydrogen, another filtration made, and the filtrate evaporated to dryness. The residue thus obtained is left in contact with ammonia for twenty-four hours, then agitated with double its volume of chloroform, and the chloroformic solution evaporated; this residue is dissolved in 2 c.c. of water containing pure nitric acid, the solution filtered, and to the filtrate a drop of solution of bichromate of potash added. At the end of a few days crystals of chromate of strychnine appear, in which the chemical characters of strychnine may be recognised. M. Cloetta affirms that, by his process, he has been enabled to prove the presence of 1-20th grain of strychnine in 650 c.c. of urine.

M. Werner has made some experiments on the crystallisation of glycerine. He was not able to form crystals by agitation or by cold. As he had recognised the presence of chlorine in some solidified glycerine, he made the experiment of passing a few bubbles of chlorine through glycerine of commerce, and, under these circumstances, small octahedral crystals were obtained possessing great hardness, but deprived of the sweet taste of glycerine even when melted.

The following is a method of examination for detecting mercury in poisoning cases, described by M. Buchner. This method was employed by M. Buchner in searching for mercury in the remains of a person poisoned by corrosive sublimate. The organic remains having been disintegrated by a hot mixture of chlorate of potash and hydrochloric acid, the solution was diluted and saturated with sulphuretted hydrogen. After the lapse of some hours the sulphide formed was collected, dissolved in aqua regia, and reduced by evaporation to a small volume. A little water being added, a bright piece of copper wire is placed in the liquid, and when mercury is present, the wire becomes grey, at the latest, in two days. The copper is withdrawn, dried between folds of blotting paper, and heated in a wide test tube. The mercury is more easily distinguished by removing the wire, and placing in the tube a drop of tincture of iodine. M. Riederer, having remarked that the sulphide of mercury which is formed by this process always contains organic matter, has recourse to dialysis. He operates in the following manner:—After disorganisation by chlorate of potash and hydrochloric acid, the mercury in solution is precipitated by sulphuretted hydrogen, the sulphide collected dissolved in a mixture of chlorate of potash and hydrochloric acid, and dialysed with 500 c.c. of water; at the end of five days the water is evaporated and the dialysis repeated. After this treatment, the solution is again

saturated with sulphuretted hydrogen; the precipitate is washed with ammonia and sulphide of ammonium, then with weak nitric acid, and finally treated afresh with hydrochloric acid and chlorate of potash. Operating upon dogs with calomel, M. Riederer has recognised that the greater part of the mercurial compound is eliminated by the excrements, and that for the rest, more collects in the liver than in the muscles.

On the 7th of December the following memoirs were communicated:—"The Mechanical Equivalent of Heat Explained by the aid of Æther, tending consequently to confirm the Existence of this Fluid, universally diffused," by M. Burdin; "Researches on Alloys," by M. Riche; "On a Natural Arseniate of Zinc occurring at Cape Garonne," by M. Damour; "Union of Free Nitrogen with Acetylene; Direct Synthesis of Hydrocyanic Acid," by M. Berthelot. M. Jenzsch addressed a complement to his note of the 21st September, "On the Fossils from Rocks, termed Eruptive." The physical section has presented the following list of candidates for the vacant place created by M. Pouillet's decease:—(1), M. Jamin; (2), MM. Bertin, Desains, Favre, Janssen, Le Roux, Lissajous, and Guet.

In a notice inserted in the *Comptes Rendus*, M. Friedel has made known the characters and composition of a new mineral found at Chanarcillo in Chili, to which he has given the name *adamine*. This mineral is formed essentially of oxide of zinc, arsenic acid, and water, and up to the present day is only found in very few collections; it has lately been found in France by MM. Gory and de Boutiny, in the refuse of a copper mine at Cape Garonne (Var). By a qualitative examination, M. Gory has recognised in this mineral the presence of arsenic, zinc, and cobalt. At his request, M. Damour made a more complete examination of this mineral. The *adamine* of the Cape Garonne occurs in small crystals, in a quartz rock; these crystals are usually lenticular, grouped and joined so as to offer some resemblance to a number of grains of wheat. Nearly all are tarnished, sometimes they are covered with small needles of arseniate of copper (olivenite). Their colour is generally grey, slightly rose-tinted; the hardness is a little greater than that of carbonate of lime. The density at + 15° C. is 4.352; M. Friedel found 4.338 for the samples obtained in Chili. The following are the chemical characters:—Heated in a tube, *adamine* evolves a small quantity of neutral water, and takes a faint bluish tint; on charcoal before the blowpipe flame, the mineral fuses into a blackish scoria, disengaging white fumes and an arsenical odour. After cooling, a white ring, tinted blue at the border, is observed to encircle the scoria. With borax or microcosmic salt, the blue colour characteristic of cobalt is obtained. Hydrochloric, nitric, and sulphuric acids dissolve the mineral completely.

On the 14th December, M. Filhol presented a memoir "On the Action of Iodine on the Metallic Sulphides." MM. Troost and Hautefeuille communicated a memoir "On some Properties of Cyanic Acid," and M. Schloësing a memoir "On the Estimation of Phosphoric Acid in Plants." At this meeting M. Jamin was elected to the vacant place in the physical section.

At the meeting on the 21st, the following memoirs were communicated:—Memoir "On the Phenomena of Static Electricity which Accompany the Rapid Destruction of the Adherence of Different Bodies," by M. Joulin; "Action of Ammonia on Phosphorus," by M. Blondlot; "On the Formation and Decomposition of Sulphides of Carbon," by M. Berthelot; "Action of Organic Acids on the Nitriles of the Fatty Acid Series," by M. Gautier; "Remarks on the Sulphide of Allyl," by M. de Clermont; "On a New Formation of Octylic Alcohol," by M. Silva; "On the Bromide of Allyl," by M. Tollens. A note by M. Ferriere, "On the Combustion of Phosphuretted Hydrogen," completes the list. Some account of these researches will appear in a future letter.

NOTICES OF BOOKS.

Chemistry for Students. By A. W. WILLIAMSON, F.R.S., F.C.S. Clarendon Press, 1868. New edition.

THE well-known text-book of Professor Williamson has reached its second edition in a short space of time, and this will show the general appreciation of it by students. The length of our notice of the first edition will render unnecessary many remarks on its nature, &c., that otherwise would be only just; but we may mention that its characteristics remain,—viz., a strictly chemico-philosophical way of looking at various subjects, with terseness and an almost universal omission of minute detail.

This has never been complained of, for Dr. Williamson from the first has expressed his opinion that books of detail should only be studied when important leading facts, that must always be retained for ready use, are first conquered. Miller's "Elements" and Watts's "Dictionary" are recommended as English handbooks to the student by our author.

Early students thus have this book prepared for them; it is not meant for school use; but the ideas expounded in these pages are essential to all for the due appreciation of organic chemistry, the latest of its results especially.

To the substance of the work no addition of great importance has been made; the number of sections remain as before; the book is essentially the old book corrected and slightly improved. The appearance of it is much neater, the paper now used being toned, and the sharpness and clearness of its printing would entitle it to a place on the drawing-room table rather than the coat pocket of the student. Two entirely new features are the addition of foot notes explanatory of subject matter, and squares for the amplification of the author's suggestion of the use of an absolute volume. The former mostly consist of equations showing the symbolical formulæ of the process described; in them are also given molecular and volumetric expressions, in addition to those of equivalence before existing in the work. The squares aroused our curiosity; we wanted to know if Professor Williamson, like Dr. Miller (who, indeed, has always patronised volume-squares), would express the square of phosphorus as half the size of the hydrogen or oxygen square, but unfortunately, this symbolic method is not carried on in the work further than the gaseous compounds of sulphur. In addition to these improvements, tables, absolute and comparative, are given of the leading salts of the elements, and the well-known consistency of Dr. Williamson's nomenclature is even more rigidly than ever enforced in the case of organic hydrogen salts. We will not say that answers are given to the problems,—far better, the problems are fully worked out; and this addition is of special value.

A very unpretending improvement will be really found most valuable to the student. We allude to the table of contents, which has been enlarged to nearly twice its size—for of all things a deficiency in this respect for rapid reference is most annoying. This improvement, we venture to say, is second to none made upon the former edition. The old edition further contained a page of matter now, we are delighted to see, omitted—we allude to the page of corrections; the misprints also, not mentioned in that table have been rectified, and we no longer find TO_4H_2 representing sulphuric acid.

The accuracy of the supervision of the text is shown in the new table of the elements, in order of their equivalency; the atomic weight of vanadium is halved and placed in the triad group, but the place claimed for it by Roscoe, in the nitrogen family, between phosphorus and arsenic, is not allowed. It will be interesting to theorists to learn that ruthenium, rhodium, and iridium are retained by our author in the group of even equivalence, and are not considered trivalent,

This group of even equivalence comprises, we are glad to see, dyads and tetrads; the hexads of Miller, Odling, Nacquet, &c., are also retained in this group, and pentads as such, as far as elements are concerned, are not recognised; neither erbium nor terbium ranks as an element. In our opinion, this philosophic caution deserves both a wide and an early imitation.

In conclusion, we may express a hope that the new edition may run as successful a career as the old, and that the next may be still further improved, and, we hope, extended, by the introduction of the author's classification of elements by their chemical reactions.

CORRESPONDENCE.

OZONE.

To the Editor of the Chemical News.

SIR,—The development of atmospheric ozone during the past month has been very abundant. I enclose the particulars of it as indicated by the test-papers, scale 0 to 10:—

DECEMBER, 1868.

1st.—8·7	9th.—9·2	17th.—7·5	25th.—8·0
2nd.—1·0	10th.—7·5	18th.—7·5	26th.—8·7
3rd.—8·5	11th.—8·5	19th.—8·7	27th.—9·0
4th.—8·0	12th.—9·2	20th.—7·2	28th.—8·5
5th.—9·0	13th.—8·7	21st.—8·7	29th.—8·5
6th.—9·0	14th.—8·7	22nd.—9·2	30th.—6·5
7th.—9·0	15th.—8·7	23rd.—8·7	31st.—8·7
8th.—9·0	16th.—8·2	24th.—8·7	

The test papers used were Schönbein's, as sold by Casella; they were hung on the inside of the roof of my thermometer stand, and were changed every day at 9 a.m.

Some experiments made in 1867 led me to hope—as I mentioned in a short communication to you (CHEMICAL NEWS, No. 425, p. 48—that moistened silver leaf might be used as a test for detecting atmospheric ozone; but further experiments made in the beginning of last year on Beachy Head gave no reliable result.—I am, &c.,

R. C. C. LIPPINCOTT, jun., F.M.S.

Over Court, near Bristol,
January 5th, 1869.

MISCELLANEOUS.

Glasgow Philosophical Society (Chemical Section).—A meeting was held in the Hall, Andersonian University, on the evening of the 21st ult., Dr. Wallace, Vice-President, in the chair. Six members were admitted, and six candidates for membership named. W. R. Hutton, Esq., read a paper on the "Igniting Point of the Vapours of some Commercial Products."

Bust of Dr. Muspratt.—The eminent sculptor, Mr. Adams-Aiton, is at present executing a portrait bust, in marble, of Dr. Muspratt, the discoverer of the chloride of iron spring, which is to be placed in the New Pump-room at Harrogate, over the "Dr. Muspratt Chalybeate." The artist hopes to have the bust ready for exhibition at the Royal Academy in May next.

Faraday on the Government Recognition of Science.—The Parliamentary Committee of the British Association applied to Faraday through Lord Wrottesley for his opinion whether any and what measures could be adopted by the Government or the Legislature to improve the position of science, or of the cultivators of science, in this country. He answered:—"I feel unfit to give a deliberate opinion."

My course of life, and the circumstances which make it a happy one for me, are not those of persons who conform to the usages and habits of society. Through the kindness of all, from my sovereign downwards, I have that which supplies all my need; and in respect of honours, I have, as a scientific man, received from foreign countries and sovereigns those which, belonging to very limited and select classes, surpass in my opinion anything that it is in the power of my own to bestow. I cannot say that I have not valued such distinctions; on the contrary, I esteem them very highly, but I do not think I have ever worked for or sought them. Even were such to be now created here, the time is passed when these would possess any attraction for me, and you will see, therefore, how unfit I am, upon the strength of any personal motive or feeling, to judge of what might be influential upon the minds of others. Nevertheless I will make one or two remarks which have often occurred to my mind. . . . A Government should, *for its own sake*, honour the men who do honour and service to the country. The aristocracy of the class should have distinctions which should be unattainable except to that of science. . . . But, besides, the Government should, in the very many cases which come before it, having a relation to scientific knowledge, employ men who pursue science, provided they are also men of business. This is, perhaps, now done to some extent, but to nothing like the degree which is practicable with advantage to all parties. The right means cannot have occurred to a Government which has not yet learned to approach and distinguish the class as a whole."—*From the Obituary Notice of Faraday in the Proceedings of the Royal Society*, vol. xvii., p. lv.

New Source of Citric Acid.—Professor O. Silvestri of the University of Catania, has recently discovered a great quantity of citric acid in the fruit of the *Cyphomandra betacea*, a plant belonging to the family of *Solanaceæ* which is found here and there in the gardens of Sicily. It is indigenous to Mexico, and has spread itself into Peru and other parts of South America, where it is called *Tomate de la paz*. It is a woody plant, and attains to the height of 4 metres. On analysis the fruit gives from 1 to 1.5 per cent of pure citric acid. This acid, which probably exists also in our edible tomato, has already been discovered by Bertagnini in the potato, and will doubtless be found in all plants belonging to this tribe.—*Cosmos*.

The Preservation of Meat.—The following is a copy of a decree, issued by the Argentine Government, which has been received through her Majesty's Minister at Buenos Ayres, offering a prize of £1,600 to the inventor or improver of the best method of preserving meat:—

"Decree.—Buenos Ayres, Nov. 2, 1868.

"In pursuance of the authority given to the executive power, by the law of the National Congress of the 7th September, to apply the sum of 8,000 hard dollars to a prize, to be given to the inventor or introducer of the system of preserving fresh meat, best adapted, in the judgment of the executive power, to its working on a great scale, the President of the Republic decrees that a term of six months is fixed, reckoned from this date, in order that those who shall consider themselves in a position to try for this prize may present their proposals, within that time, to the Ministry, to be examined in the way the Government may think fit.—" (Signed) SARMIENTO DALLMATIUS VELEZ SARPFIELD."

NOTES AND QUERIES.

Siam.—Your correspondent, "Oriens," who desires information about the kingdom of Siam, will, perhaps, most readily obtain the information he requires by either politely addressing the Right Hon. Sir J. Bowring, who, according to the "Almanach de Gotha" for 1869,

is the Envoy Extraordinary and Minister Plenipotentiary for Siam to the Court of St. James's, or by applying to D. M. Mason, Esq., Consul for Siam, residing in London.—D.

Vitriol Chambers.—"G. N." wants to know the best shape for vitriol or sulphuric acid chambers. Without entering into details concerning the theory and practice of the manufacture of sulphuric acid, full particulars of which are given in Richardson, Watts, and Knapp's "Technology," it may be briefly stated that the shape usually adopted has been found to answer the purpose best, because it best admits the proper play of reactions to take place between the various materials, which results in the formation of sulphuric acid; if, instead of sulphur, sulphur ores (pyrites) are used, the capacity of the chambers should be relatively larger to obtain the same quantity. The shape adopted for sulphuric acid chambers has been found on experience to be not only the most suitable, but the only practically suitable for success on the large scale.—Dr. A. A.

MEETINGS FOR THE WEEK.

MONDAY, 18th.—Medical, 8.
— London Institution, 6.
TUESDAY, 19th.—Royal Institution, 3. Mr. Westmacott, "On Fine Art."
WEDNESDAY, 20th.—Meteorological, 7.
— Society of Arts, 8.
THURSDAY, 21st.—Royal Institution, 3. Mr. Rupert Jones, "On Entozoa."
— London Institution, 6.
— Royal, 8½.
— Zoological, 4.
— Chemical, 8.
— Royal Society Club, 6.
FRIDAY, 22nd.—Royal Institution, 8. Prof. Herschel, "On the Last Eclipse of the Sun."
— Quekett Club, 8.
SATURDAY, 23rd.—Royal Institution, 3. Professor Odling, F.R.S., "On Hydrogen and its Analogues."

TO CORRESPONDENTS.

* VOL. XVIII. of THE CHEMICAL NEWS, containing a copious index, is now ready, price 11s., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes, are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xix. commenced on January 1st, and will be complete in twenty-six numbers. It will contain a verbatim report of Dr. Odling's Juvenile Lectures at the Royal Institution "On the Chemical Changes of Carbon," and original papers from some of our leading English and Foreign Chemists and Physicists.

J. Wallace.—The *Bulletin de la Société Industrielle de Mulhouse* can be obtained through any foreign bookseller, or it can be seen at the Patent Office Library, Chancery Lane.

Dr. F. Hirsch.—Our correspondent's communication on "Carbolic Acid" is duly received, and shall be inserted in an early number.

R. F. Wheeler.—Messrs. Prentice and Co., Stowmarket, supply all the preparations of gun cotton. We are not able to inform you where dynamite is to be procured.

C. Horner.—1. A Bunsen burner is preferable to a spirit lamp for experiments in spectrum analysis. If you require more heat, use a fine blow-pipe flame, but nothing will replace the induction coil for experimenting on many metallic compounds. 2. In making oxygen from manganese and chlorate of potash there is no danger provided the exit pipes are wide enough to avoid getting blocked up. 3. A glass retort will not do to decompose binoxide of barium in by heat.

J. Brode and Co.—There will be no loss of delicacy if you replace the steel knife edges of your balances by agate. We have used agate edges on agate planes for years, and prefer them to steel on agate, as they do not deteriorate in a laboratory. The shape of the knife edges is the same in each case. You will find it advisable to have the alteration done by a workman experienced in the manufacture of balances, as they will be sure to require re-adjustment.

Communications have been received from Dr. R. Angus Smith, F.R.S.; G. F. Rodwell; S. Mellor; W. T. Suffolk; G. Foord; G. Marrison; R. F. Wheeler; G. Wharton Simpson, M.A.; Dr. Sheridan Muspratt; Dr. Joseph Hirsch, Chicago; J. Wallace; Messrs. Muir, Brown, and Co.; C. Horner; Dr. Otto Richter; J. Brode and Co.; Dr. E. Röhrig; R. E. Tatlock; E. C. C. Stanford; J. Morris (with enclosure); W. Briggs (with enclosure); R. Mallet, F.R.S.; Stanislas Meunier; J. and E. Sturge; J. A. Brand; M. A. Gage; G. Maxwell; Muspratt, Bros., and Huntley; A. Hedley; T. Blair; C. Barrett (with enclosure); J. Morris (with enclosure); and J. Wallace (with enclosure).

THE CHEMICAL NEWS.

VOL. XIX. No. 477.

ON THE CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*
(ADAPTED TO A JUVENILE AUDITORY),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN,
(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, Esq., M.B., F.R.S.
(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE II.

CARBONIC GAS—AIR—OXIDES.

(Continued from page 28.)

I WANT now to consider how it is that this carbonic gas gets into the air—by what process charcoal is converted into carbonic gas, and how the air comes to contain it; and for this purpose it is necessary that we should again turn our attention away from charcoal and consider for a few minutes the nature of air. I must here call your attention to some historical facts in connection with it. What sort of a substance is air?

The first point to which I want to call your attention is that air is a real material substance. At the commencement of my first lecture I told you that you had come to the Royal Institution to learn about *things*—about things that could be touched and weighed. Now I am talking to you about air. Is air a *thing*—something that can be touched and weighed? Let us begin gradually; if we take a block of wood and press it between our hands, we find that it is sensible to the touch. This capability of being felt has received various names. Sometimes it is called “impenetrability,” because one body cannot occupy or penetrate the space that is being occupied by another body; sometimes it is called “extension,” because the body extends, between my hands for instance, and keeps them apart; and it is more commonly called “resistance,” because the substance resists, as this wood does, my hands. Whether you call this property impenetrability, extension, or resistance, the word means the same thing. It means that the body is capable of being felt. A solid body, we know, is capable of being felt; but when we come to the case of sand, and when I press

it between my hands, it does not keep my hands apart like the block of wood. Hence you might say at first sight that the sand does not possess this property of impenetrability or extension or resistance; but if we put the sand into a bag so that it cannot make way for my fingers, it then keeps my fingers apart, and resists the pressure of them just as the block of wood did, and so we must say that it has impenetrability. A tight bag of sand might be regarded almost as a hard solid substance; it is capable of striking a very heavy blow, and, indeed, was formerly used for that purpose. When we pass from such a substance as sand to a liquid substance like water, we find that it keeps the hands apart still less forcibly than the sand, and you may say that it is perfectly penetrable. Well, it is penetrable in one sense, but not in another. If I put water into a bladder, the water not being able then to make way for my fingers will keep them apart, and that is what we call the capability of being felt—the property of impenetrability or extension. Again, we cannot, under ordinary circumstances, feel the air, but if the air is placed in a bag, like sand or water, we can feel it perfectly well. Here I have a bladder of air, and I can feel that there is something in it which my fingers cannot penetrate—which resists their pressure—which extends between them, and therefore we say that the air is possessed of this capability of being felt which constitutes it a *thing*. But is it also capable of being weighed? Can we weigh air? I think we can. Here is a flask from which the air has been removed by a means to which I do not intend now to direct your attention. We place this flask on a balance, and it is now more than balanced by a weight on the opposite side, for the weight is heavier than the flask. I will let the air rush into the flask, and you will see under these circumstances that the flask will become heavier than the weight: at present the counterpoise is heavier than the flask. Now listen!—[opening the stopcock to admit the air.] You hear the air going in, and you see that the flask becomes heavier than the weight on the other side of the balance. Not only is air possessed of weight, but it is really very heavy. A cubic foot of air weighs something between an ounce and an ounce and a quarter. You might think that we ought to be able to feel its weight, and here I will devote a few minutes to explaining to you the recognition of atmospheric air as a material substance. Thoughtful people in all ages have taken notice of the air, but there must have been a lapse of at least 2,000 years between the first scientific notice of the air and the discovery of the fact that the air was a thing or substance. It was not until the year 1643 that atmospheric air was recognised to be a substance possessed of weight and capable of being felt, so that,

* Reported verbatim, by permission of the Author, for this Journal.

although the air is a weighty substance, yet its weight is not very easily appreciated. You are not yourselves conscious of its being weighty, and for 2,000 years after mankind had begun to think of it, and perhaps for as many years before, they were quite unconscious that it was a substance possessed of weight. They said that if it was weighty its weight ought to be perceptible. Now the reverse is the truth; if it is weighty you ought *not* to feel it. It would take me too long to explain this to you, so I will give you an illustration instead, and I want you all to see it. This is a large tube closed with a bladder; at present it is nearly full of coloured water, and it is quite obvious that the bladder has to support the weight of the water, and from this cause you see it becomes extremely taut, and shows unmistakable evidence of the water pressing upon it. If I lower the tube into this jar containing colourless water so that the water is as high outside as it is inside, you will see that the bladder becomes unconscious of the weight of the water. There is water as before, but still the water on each side is so exactly balanced that the bladder is no longer conscious of it. Now again, [lifting the tube out] the bladder is extremely taut: very likely a little more will burst it; but directly I lower it into the vessel so as to have the water level on the inside and on the outside of the tube, the bladder becomes perfectly flaccid and insensible to the weight of the water, just as we are insensible of the weight of the air by which we are surrounded. Take another illustration. In each of the pans of this balance is a pound weight, and the pans now perfectly balance one another. Under ordinary circumstances a feather would be quite incapable of raising a pound weight; but in this instance you will see that it will suffice to do so. If I take this feather in my hand and gently raise it under one of the pans containing a pound weight, it raises it up above the other; the reason of this is that the weight on one side is so exactly balanced by that on the other side, that the feather is not sensible of the weight it is moving. In the same way we are insensible of the weight of the air in which we live, because really that weight is not supported by ourselves, but by that of the surrounding air. So much, then, for the question of the weight of air.

The discovery of the weight of the air was made in 1643; from the year 1643 to the year 1756 mankind were of opinion that there was only one kind of air, although many of them knew that air could differ in some respects. They were aware, for instance, that the air of the town differed from that of the sea—that some air had different properties from other air; but they never recognised these different kinds of air as distinct substances. They rather looked

upon the difference as being of a similar kind as that between different sorts of water. You know there are rain water, river water, sea water, and spring water; but all these consist essentially of the same substance—water—together with certain impurities. Well, from the year 1643 to 1756 mankind thought there was but one kind of air, and that the differences were due to impurities which gave the various airs a different character, just as sea water differs from common water because there is a little sea-salt dissolved in it, and so on. In reality, however, there are essentially different kinds of air. First of all, we find that there are airs of different colours; here is some of a decidedly green colour; in this other bottle we have some of a brown colour—so that we are acquainted not only with colourless air, but with airs of different colours, just as we may have liquids of different colours; but when we recognise no difference by the colours of air, we may recognise them by other means. For instance, if I take a taper and introduce it into what we call an empty bottle—that is, a bottle containing ordinary air—the taper continues to burn perfectly well, but if I take it out of this bottle containing ordinary air, and insert it into this other bottle, we find that the taper is at once extinguished by our old friend, fixed air, or carbonic gas; and this was the first air discovered as differing from ordinary air. It was discovered in 1756, and it differs from ordinary air in containing carbon.

We will now take another kind of air, which is colourless, and looks like ordinary air; we will apply a light to it and try what will be the effect—whether our light will continue to burn. [On the experiment being tried, the light was immediately extinguished.]

This, then, is a third kind called *azotic* air. Those of you who are Greek scholars will know that *azotic* air means lifeless air, and it was so called because it will not support life; it has also been called *phlogistic* air; it is now termed *nitrogen* gas, because it is capable of producing, or being produced from, nitre.

Here we have some air, which, when a light is applied to it, burns with a flame. This air was originally called inflammable air; it is now called *hydrogen* gas, because it enters into the composition of water.

You saw that when I introduced the taper into the *azotic* air, or nitrogen gas, the light at once went out. In this respect, then, *azotic* air behaves exactly like carbonic gas; but it differs from carbonic gas in this particular—that it is not capable of being fixed by means of lime-water. We will shake up some of this gas with lime-water, and you observe that the lime-water remains perfectly clear; whereas, if we had taken the bottle containing carbonic acid,

the lime-water would have become milky, in consequence of the formation of chalk. Therefore this azotic air corresponds with the fixed air in not allowing bodies to burn it, but it differs from the fixed air in not rendering the lime-water turbid.

We now come to another kind of air. It was discovered in 1774, and was originally called *vital air*; we now call it *oxygen* gas. On introducing the lighted taper into this oxygen, we shall see whether the taper burns as in ordinary air, whether the gas takes fire, or what happens to the taper. We introduce it, and you see with what increased brilliancy the taper burns. This, then, is a fourth kind of air we are dealing with.

I will finally call your attention to a fifth kind of air, called *marsh gas*; this is an essential constituent of ordinary coal gas. You are all familiar with the appearance coal gas presents when it is being used in the ordinary way for lighting. You observe, when we set fire to this marsh gas, it at once burns in a similar way. It was originally called heavy inflammable air, because it is much heavier than ordinary inflammable air, or hydrogen. Thus, you see, chemists are acquainted with a variety of kinds of air.

We will return to this fixed air, or carbonic gas, or gas from charcoal, and the way in which it gets into the atmosphere. And this leads me to make some remarks on the miscibility of different kinds of air with each other. I will illustrate this by reference to certain liquids, and first let me call your attention to this cylinder, at the bottom of which I have poured some of the heavy liquid mercury. Upon the mercury is the colourless liquid chloroform, which is also heavy; and then upon that some water, which I have coloured in order to make it more evident. Thus we have three different liquids in the cylinder, standing in layers one upon the other, and not capable of mixing. If I put a stick into them, and stir them up, they soon settle again into distinct layers. I can even pour upon the water another liquid—ether—and in this way we shall have four immiscible liquids together in the jar. Thus we have four liquids in the vessel—mercury at the bottom, chloroform next, then the coloured water, and the colourless ether at the top—four liquids which are not capable of mixing. There are, however, certain other liquids which are capable of mixing with each other, and I will now draw your attention to some of them. Here I have another cylinder, with some coloured liquid at the bottom and some colourless liquid at the top; the first is coloured water, and the other is spirit of wine. If I stir up these liquids, they mix, and will not again separate. Now here is a cylinder which looks at first sight

as if it contained only one liquid, but, in point of fact, it contains two—water at the bottom and spirit of wine at the top; and I daresay I can render this evident to you. If I introduce into the cylinder a piece of wax, and allow it to drop gently into the liquid, you see it drops only half way; the wax drops through the spirit of wine, for it is heavier; but being lighter than the water, it floats on the top of it. In such cases, although the liquids are capable of mixing when one is lighter than the other, you may, by using care, put the lighter liquid at the top of the heavier one. Now, if I shake these together, we shall get a mixture of spirit and water containing so much water that the wax at once floats at the top. In point of fact, then, these liquids do not differ so much from one another with regard to their miscibility as the liquids to which I first called your attention. With regard to liquids, we find, then, that some will mix and others will not. With regard to gases, however, we found that all gases will mix; we can put one gas at the top of another, and keep it so for a short space, but after a time the two gases will mix completely. For instance, here is a brown-coloured gas. Now I can put on the top of this a cylinder of air, and we shall have in that way a colourless gas floating on the top of a coloured gas, just as we had a coloured liquid floating on the top of a colourless one; but you will observe that the brown gas will gradually mix with the colourless gas, even without much agitation.

We will now take another illustration, and one in which we shall be able to make a comparison similar to the floating of the piece of wax on the surface of the lower liquid. Here is a cylinder apparently empty, but in reality containing at the bottom of it some fixed air, and the upper portion of the cylinder is filled with ordinary air. Thus we have two colourless gases in that cylinder just as we had two colourless liquids in the vessel we had before us just now. I shall be able to show you the point to which the lower gas rises. If we introduce into this cylinder a jet of burning gas, it burns perfectly well while in the air, but when we allow it to go a little lower it comes into the fixed air, and the flame is immediately extinguished. You see, then, that this jet of flame finds out the margin of the heavy and the light gas just as the wax found out the limit of the two liquids. Directly this flame is lowered into the carbonic gas it ceases to burn. You see, therefore, that you may have in the same cylinder two different airs floating one on the top of the other, just as you may have two liquids one on the top of the other; but eventually you will find in the case of the gases that, whether they are in a state of agitation or in a state of rest, they will mix perfectly with each other.

Now comes the question,—is the ordinary atmospheric air with which we have to deal a single gas or a mixture of different gases? I might call your attention to a great many experiments illustrative of the fact, that ordinary atmospheric air is really a mixture; and here is one. You know that many metals have the property of rusting. Some of them rust very quickly, like iron: others of them rust very slowly, like mercury, copper, or silver. Now, if you take such a metal as iron, which rusts tolerably quickly, and put it into a confined space of air, the iron gradually rusts, and as it rusts the volume of air grows less and less until, in fact, the five volumes of air are reduced to four; now, this has taken place in the present instance. Here you have a cylinder which was full of air; some iron wire was put into it, and it has at last sucked up one-fifth of the air. Here, again, is a piece of phosphorus on the end of a stick, and this piece of phosphorus is rusting just in the same way. The phosphorus will go on rusting until the liquid in the cylinder rises up one-fifth, and then the rusting will entirely stop. We find, then, that one-fifth of the bulk of the air is capable of being absorbed by rusting iron and by rusting phosphorus, and also by burning phosphorus. We will take some phosphorus and burn it under a cylinder inverted over water. We dry a small piece of phosphorus on a piece of paper, and place it on a piece of cork, and burn it under the cylinder, and as it burns you will find that the water will gradually rise in the cylinder until it reaches one-fifth of the way up. [The experiment was performed with the result described.] Now, instead of burning a piece of phosphorus, I will in the same way burn a piece of candle also floating upon cork, and you will see, as before, that as the candle burns the water rises in the glass vessel.

I must defer further consideration of this property of different kinds of gas to mix with one another to my next lecture; but before I conclude I wish to show you two more experiments in illustration of my lecture.

First of all, I told you that air is a material substance. Here you have an illustration of it; here is a flask of coloured water inverted over what appears to be an empty bottle, and the neck of the upper flask communicates with the neck of the vessel underneath. Now why does not the water run out into this lower flask? Because that flask is *already full*. It is already full of air, and the air cannot get out, and therefore the water from the upper bottle cannot get in; but if I just for a moment allow the air to escape from the lower flask, the water will run in from the upper vessel. If I close the receiver, you see that in a moment or two the water ceases to run, because the air con-

tained in the receiver cannot escape to make room for it.

The other experiment is one intended to illustrate the way in which air tends to magnify the appearance of some substances. Here we have a large glass jar which appears to be full of cotton wool. In reality cotton wool occupies a very small portion of the jar, which is filled chiefly with air. I daresay you will be surprised to find that the whole of the wool may easily be put into this cylinder which seems to be already almost full of spirit. [The smaller cylinder was of about one-eighth the capacity of the large cylinder containing the dry wool, and was nearly full of spirit of wine.] We will colour the spirit blue to make it visible to you all. [The lecturer then began to transfer the wool from the large jar into the small vessel containing the spirit; the wool so transferred was compressed at the bottom of the liquid by means of a glass rod. After continuing the operation for a short time the lecturer proceeded,—] We have put a large portion of the wool into the cylinder, but the cylinder is not full; it is apparently no fuller than it was before, and if I put the wool in carefully I shall be able to go on until the whole of the wool is transferred.

FORMATION OF AN ARTIFICIAL SPECTRUM

WITH A FRAUNHOFER LINE.

By A. WALLNER.

If, by means of a Holtz machine, at a short distance, the rapid discharges of a Leyden jar of about 30 square centimes are passed into an ordinary Geissler tube, and if the tube is placed before the slit of a spectroscope, the spectrum of the gas which fills the tube is first seen. If the length of the discharge is increased a little, the sodium line immediately appears as in the case of induction currents, by heating the capillary part of the tube placed before the slit. With a proper length of spark the brilliancy of the sodium line far exceeds that of the spectrum of the gas. By further increasing the distance of the discharge, the calcium line is produced with such intensity that it cannot be seen to greater advantage by any way hitherto known. Finally, if the length of the spark is again augmented, the phenomenon changes, the light in the tube assumes a dazzling splendour, this luminous line forms a continuous brilliant spectrum in which the spectroscope reveals a completely black line instead of the sodium line; this, therefore, is a Fraunhofer line. If the tube is attentively examined after this experiment, one can connect the phenomenon with the explanation which M. Kirchhoff has given of the spectrum rays. The inner surface of the capillary tube is thickly corroded in consequence of the particles of glass taken away by each discharge, so that by prolonging the experiment, the glass may be completely roughened. These particles immediately raised to incandescence by the discharge, give the sodium line; but soon the tube is filled with sodium vapours, which then absorb the light proceeding from the solid incandescent particles; these form a kind of solid incandescent nucleus surrounded by an atmosphere of vapour.—*Ann. de Pogg.*, cxxxv.

ON AN OXALATE OF MANGANESE.

By Prof. HOW, D.C.L., Windsor, Nova Scotia.

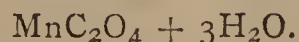
HAVING, in the course of some experiments on manganese, of which an account may soon appear, observed the formation of an oxalate of the metal, which does not seem to have been accurately analysed, I offer the following notice of the salt. The only analytical detail I have been able to find on the subject is in Gerhardt's "Traité de Chimie Organique," vol. i, p. 254, where this statement occurs:—"Oxalates de Manganèse.—Lorsqu'on fait dissoudre le carbonate manganéux dans l'acide oxalique, il se dépose dans la liqueur une poudre blanche, légèrement rosée et cristalline, presque insoluble dans l'eau. Elle paraît contenir 5 atomes d'eau de cristallisation." I think, for reasons now to be given, that the composition of the salt is not as it is thus said to appear. The subject of my communication was formed by precipitation.

When a strong solution of oxalic acid is added to one of sulphate of manganese, in the cold, an almost immediate precipitate of colourless needles begins to form, which becomes more abundant on standing. When neutral oxalate of ammonium is added to excess of sulphate of manganese and the mixture is briskly stirred, a copious white powdery deposit results, which is seen under the microscope to consist of minute needles. Almost the whole precipitate falls in a few minutes, and when it is deposited no oxalic acid can be detected in the solution by salts of calcium. The crystalline deposits from such acid and neutral fluids consist of the same oxalate of manganese; the salt has a pale rose tint when collected.

In the following analyses the water was determined at 212°, the manganese by ignition. The accurate estimation of the oxalic acid was not attained, because the salt is insoluble in acetic acid and is decomposed by ammonia, apparently with formation, according to Gerhardt, of a double oxalate of ammonium and manganos-ammonium. In the two attempts made, one by adding to the salt first acetic acid, then excess of NH_3 , filtration from a small floccy precipitate, and subsequent addition of CaCl_2 and acetic acid, the other by solution of the salt in dilute HCl , and consecutive addition of chloride of calcium and acetate of potassium, the oxalate of calcium formed contained manganese. The salt was analysed in the air dry state; the result under I. was from a deposit from the neutral, the other numbers were from the crystals formed in the acid fluid described:—

Calc.		Found.		
		I.	II.	III.
MnO	= 71 — 36.04	36.90	35.97	37.10
C_2O_3	= 72 — 36.55			
$3\text{H}_2\text{O}$	= 54 — 27.41			26.72
	197	100.00	100.00	100.00

The experimental percentages obviously agree with those calculated, hence the composition of the salt is shown by the expression:—



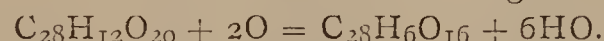
As regards the statement of Gerhardt above given, which refers to a salt resembling that now described, doubtless the same, I find the theoretical percentage belonging to the formula assigned to the salt, which is, in the notation of the period, $2(\text{C}_2\text{O}_3, \text{MnO}) + 5 \text{ aq.}$, is 23.93, and I think the loss at 212° must have agreed with this, while a prolonged heating at that temperature would have brought the amount up to that given above. I say this because I have found that the salt of different preparations gives off the first quantities of water with unequal facility, and sometimes loses the rest so slowly that if weighed at short intervals it may be considered dry when it is not so. In my examination I thought I had at least two or three definite hydrates at 212°, but found eventually that all the water is really expelled at this temperature. The salt is efflorescent to a certain extent, and hence generally gives

too little H_2O and too much MnO on analysis. It has a neutral reaction, and does not dissolve in boiling water. It is curious to find this salt forming in presence of free sulphuric acid. I believe it not to be the only oxalate of manganese, for I have observed the formation of transparent granules, either globular or polyhedral with very small faces, among the needles in the neutral fluid, mentioned above, left standing. The oxalate analysed dissolves only partially in solution of oxalic acid on boiling.

FORMATION OF ELLAGIC ACID BY MEANS OF GALLIC ACID.

By M. J. LÖWE.

By heating nearly to the boiling point for several hours in an aqueous solution of two equivalents of gallic acid and one of arsenic acid, a crystalline precipitate is deposited, which is none other than ellagic acid; the best way is to mix the two acids in the proportion indicated above, add water, evaporate to dryness, heat in an air bath to 120°, and extract with alcohol at 90°, which does not dissolve ellagic acid. The reaction is the following—



In commercial tannin there is always gallic acid, and consequently ellagic acid which proceeds from it. A cold extract of oak bark gives by degrees a yellow deposit of ellagic acid, and it is, indeed, this same acid which constitutes that gelatinous covering which is formed over tanned hides.—*Journ. de Chim. Prat.*

ON THE IGNITING POINT OF THE VAPOURS OF SOME COMMERCIAL PRODUCTS.*

By W. R. HUTTON, Esq.

It is a well-known fact that many commercial products at certain temperatures give off an inflammable vapour, and my object in bringing this paper before the Chemical Section is to give the results of comparative trials of the igniting points of a few of the leading articles of commerce, and also to explain the method employed by me in testing, which is very simple and sufficiently accurate.

In commerce there are several substances which, at the ordinary temperature of the atmosphere, are sufficiently volatile to emit enough vapour to form, with atmospheric air, an explosive mixture. There are many others which do not volatilise at quite so low a temperature, but which in a warm room, or exposed to the sun's rays, do give off vapours sufficient to render them dangerous; and there are others, again, that require to be considerably raised in temperature ere vapour is evolved, and, in consequence, may be considered sufficiently safe where ordinary care is employed.

I wish it to be distinctly understood that it is the vapour evolved from ordinary commercial substances, and not the point at which the substance itself will ignite that my results refer to. To illustrate the difference in the igniting point of the vapours evolved from different articles of commerce, I pour into one glass a small quantity of sulphuric ether, and into another glass the same volume of ordinary paraffin oil. The one substance—ether—is known to be very volatile, and on bringing a light to within half an inch of its surface an explosion takes place; the other—paraffin oil—is found not to be explosive at the temperature of this room, as it requires

* Read before the Chemical Section of the Glasgow Philosophical Society, Dec. 21st, 1868.

a higher temperature to evolve vapour before an explosion will take place.

In the subjoined table, shewing the results of experiments made by me, the samples having been purchased in the usual way, I give the specific gravity of the different commercial products, and the temperature at which their vapour explodes when a lighted taper is kept at $1\frac{1}{2}$ inches from the surface; and also the temperature at which the vapour explodes when the lighted taper is kept at only half an inch from the surface:—

IGNITING POINT OF THE VAPOURS OF SOME COMMERCIAL PRODUCTS.

	Specific Gravity.		Taper $1\frac{1}{2}$ inches from Liquid. ° F.	Taper $\frac{1}{2}$ inch from Liquid. ° F.
Sulphuric ether .. ..	.747	under	53	—
Bisulphide of carbon	1.270	—	53	—
Petroleum spirit .. ..	.706	—	53	—
Paraffin spirit .. ..	.751	—	70	68
Benzole, 90 per cent..	.861	—	74	71
Crude paraffin oil ..	.849	—	74	72
Ditto naphtha .. ..	.884	—	78	74
Brandy .. ..	.940	—	—	85
Wood naphtha .. ..	.840	—	88	81
Crude paraffin oil ..	.891	—	89	84
Ditto naphtha .. ..	.881	—	90	86
Holland gin .. ..	.930	—	—	90
Rum .. ..	.936	—	—	90
Methylated spirit ..	.827	—	97	86
Burning coal naphtha	.859	—	100	91
Spirit of wine .. ..	.817	—	104	73
Whisky, 25 O.P. ..	.893	—	109	83
Ditto 11 O.P. .. ..	.905	—	110	84
Petroleum oil .. ..	.801	—	118	110
Light pitch oil .. ..	.920	—	119	109
Resin spirit.. ..	.922	—	122	106
Turpentine.. ..	.875	—	130	119
Sherry wine .. ..	.993	—	—	130
Port wine	1.003	—	—	130
Refined paraffin oil ..	.809	—	134	123
Ditto .. ..	.814	—	138	127
Fusel oil .. ..	.850	—	140	129
Resin oil .. ..	.987	over	212	—
Heavy pitch oil.. ..	.950	—	212	—

It will be observed that the specific gravity bears no relation to the temperature required to expel vapour from many of the products mentioned in the table, and this, in some instances, arises from the fact that they are not isolated chemical substances, but consist of distinct compound bodies mixed together, the lighter of which usually, but not always, distils off first. This is very well shown from the results obtained in experimenting on the two samples of crude and the sample of burning naphtha, the benzole having been separated from the latter by fractional distillation. In the crude naphtha, there always exists a large proportion of tarry matter and naphthaline, and with a gravity approaching to .890 as compared with burning naphtha, which has been freed from all tarry matter, and has a gravity not exceeding .860; it is not to be expected that the crude will give off vapour as readily as the refined. This has been the case, however, as is indicated by the table of results. The crude gave off vapour at a much lower temperature than the refined burning naphtha; and the same remark applies to the results obtained from crude and refined paraffin oils from which paraffin spirit has been separated. In the case of spirit of wine and different proportions of water, and also of liquids that will mix with water, a deduction from the specific gravity might be made, which would at once indicate the igniting point of the vapour, and also the percentage of spirit in it; this, however, I have not gone into. The proportion of volatile matters to be found in different crude commercial substances is exceedingly variable, and therefore no line for guidance do I offer; but in manufactured articles of

commerce, where a volatile and a less volatile mixture are together, the manufacturer and the merchant have it in their power to exact a standard at which the vapour will not ignite. A very small percentage of a volatile compound is sufficient to make the whole bulk dangerous, and in some instances accidents from this circumstance are very apt to arise. In the printed table I have light pitch oil, the vapour of which explodes at 119° F.; this point of ignition is not what is considered at all dangerous as compared with bisulphide of carbon or benzole; it is, however, equally dangerous, and for this reason—that the latter is known to give off inflammable vapour which ignites at a low temperature, while the former, on account of its familiar name—pitch oil, or creosote—is looked upon as not at all explosive. In this sample of light pitch oil, the volatile matter which gave off inflammable gas at 119° did not exceed 2 per cent, after which no combustible vapour was given off until a temperature of 180° was reached, thus clearly showing that the low explosive points of the vapours of some commercial substances depend upon a very small percentage of volatile extraneous matter.

Now I shall explain the small apparatus used in estimating the igniting point of the vapours, and which is very simple.

It consists of a water-bath, with basin thermometer and spirit lamp. In operating, I put the same quantity of cold water into the bath each trial, in order that the time required to raise the temperature of the water is as nearly as possible the same. Into the small basin I put a known measure of the liquid under examination (in this instance, also, the same volume is always used); the thermometer is then adjusted with the bulb immersed under the liquid in the basin. The spirit lamp is now lighted and placed under the bath—the water in the bath is gradually warmed, which, in its turn, heats the liquid under trial. The rise of temperature is indicated by the thermometer, and by means of a lighted taper and careful attention it is easy to catch the first flash of vapour evolved. In order to have exact comparative trials, it is not only essential to have all the experiments conducted on the same principle, as regards detail, but it is also of the greatest importance that the surface of the liquid, and the taper used in catching the exact point at which the vapour explodes, shall be at an equal distance in each case. This point is of the first importance to all who test the igniting point of vapours; and to explain this statement more clearly, I have printed on the table the results of experiments made on the same commercial samples, keeping the lighted taper $1\frac{1}{2}$ inches from the surface of the liquid, in one case, and in the other at only half an inch from the surface of the sample under trial. The results are as expected—when the vapour has to diffuse and mix with atmospheric air through a space of $1\frac{1}{2}$ inches, it is found that a greater temperature is required in order to evolve the larger quantity of vapour, than in the experiments of only half an inch between the lighted taper and sample; and this is explained by the circumstance that the vapour, immediately on being liberated, mixes with the small volume of atmospheric air in the experimental basin, forming with it a mixture which, on meeting a light, explodes. In the other set of experiments, a greater temperature is required to disengage a larger volume of vapour to mix with the greater proportion of air.

In this paper I have carefully avoided mention of the relative danger of the articles of commerce examined by me; the table gives, however, the names of several compounds the vapours of which readily explode, and it is with the object of having a uniform method of testing that point of danger that I now submit a method which I consider sufficiently accurate for all comparative trials. Without a uniform method no two results will agree; but with a recognised method, both manufacturers and merchants would know what the igniting point of the vapour of commercial substances exactly means, and a

security to consumers and others that does not now exist would be obtained.

NOTE.—The Petroleum Act of 1868 enforces a uniform method of testing the point at which vapours are evolved to form explosive mixtures with air; but this applies only to paraffin, petroleum, and coal oil products, and does not refer to other commercial substances, several of which are equally, and others more dangerous, than paraffin and petroleum oil.

Dr. WALLACE gave additional information relating to the new Petroleum Act, and described the apparatus which must be used for testing in order to conform to its requirements.

Dr. CLARKE stated that, in the case of liquids having a low inflaming point, the temperature at which the first flash took place was generally only a few degrees below that at which the bulk of the liquid was inflammable, but that with liquids which had a high inflaming point, the temperature at which the first flash took place was removed from that at which the liquid itself inflamed, by 10° or even more. He also stated that he believed the insurance companies had divided oils into three classes, having different inflaming points—the first, or least inflammable, being represented by olive oil; the second, by Price's cloth oil, which ignites at about 346° F.; and the third embracing all oils having a lower igniting point than Price's cloth oil, a margin of a few degrees being allowed. He also pointed out that the igniting point of an oil (the only test required by insurance companies) was no criterion of the readiness with which it undergoes spontaneous combustion when spread over a cotton surface.

Mr. TATLOCK believed that much misapprehension had arisen from a misunderstanding on the part of commercial men as to the true meaning of the term "igniting point," and referred to the fact that the igniting point, properly so-called, of any gas or vapour was seldom, if ever, under a red heat, whereas the igniting point, commercially speaking, was simply the point at which sufficient vapour was given off to form an explosive mixture with air in contact with a red-hot body, the latter condition requiring always to be fulfilled before an explosion could happen.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

MICROSCOPICAL AND NATURAL HISTORY SECTION.

November 9th, 1868.

J. B. DANCER, F.R.A.S., President of the Section, in the Chair.

Mr. SIDEBOTHAM exhibited specimens of the gall fly, *Cynips Lignicola* and a number of the galls formed by this species. He stated that these galls are very common, apparently much more so than a few years ago; he had tried an experiment to ascertain their commercial value, and exhibited the comparative strength of colour from them and from the blue Aleppo galls. The English galls are much lighter, and in the experiment equal weights of each were used. The result of the experiments showed that the English galls were about two-thirds the value of the foreign ones, or, according to the present market value, they would be worth about 66s. a hundredweight. In the plantations where these galls abound, he thought a man might collect easily half a hundredweight in a day, and, on the principle that nothing valuable should be wasted, he thought that it was very desirable that these galls should be collected and made use of. The galls, even

when in great numbers, do not appear to injure the trees. The proper time to collect them would be the middle of September, when the flies have all eaten their way out and laid their eggs for another year's supply.

Dr. ALCOCK showed a preparation preserved by corrosive sublimate in a manner which he recommended for fine dissections. The preparation had been kept in an open cup for twelve months, simply water being added occasionally to supply what was lost by evaporation. The advantages of the plan were, very perfect preservation, no necessity for closing up so that the specimen could not be got at, no fear of losing a valuable dissection from accidental evaporation, as where spirit is used, and cheapness. The method adopted was to prepare a saturated solution of corrosive sublimate in alcohol, and when a dissection in water is in progress, a small quantity, as half a teaspoonful, of the solution is to be added from day to day if the slightest appearance of putrefaction is observed, but no more of it is used than is absolutely necessary, and by the time the dissection is completed, the specimen has become imperishable, from the union of the corrosive sublimate with the tissues, and it may then be kept in pure water, either open or mounted in the usual way.

NEWCASTLE LITERARY AND PHILOSOPHICAL SOCIETY.

ON Thursday, December 24th, 1868, Mr. J. LOWTHIAN BELL delivered the inaugural address of the newly-formed Chemical Society. We regret that pressure on our space will only allow us to give a short notice of the address, which is full of scientific interest, and will, we have no doubt, be the means of increasing the zeal of the founders and members of the society. Mr. Bell reviewed the history of the various chemical compounds now manufactured on a very large scale on the banks of the Tyne, and which furnish a field of enquiry and research rarely or never at the command of the man of science. As instances of the advantages possessed by manufacturers for promoting chemical science, the speaker quoted the discovery of selenium and thallium, found in infinitesimal quantities in the slow accumulations of sublimate in our vitriol chambers, while bromine as well as iodine were first noticed in the concentrated mother waters obtained in treating sea water and the incinerated portions of marine plants. Mr. Bell also made some excellent observations on the discoveries of Kirchhoff, Miller, Huggins, Joule, and others in connection with spectrum analysis; on the investigations of Professors Graham and H. St. Claire-Deville on the absorption and dialytic separation of gases by colloid septa; on the production of the submarine cable by insulating copper wire by means of gutta percha; and on Mr. Ansell's ingenious apparatus for indicating the presence of fire-damp in mines. At the conclusion of the address the speaker dwelt at some length on the several means possessed by the members of the society for promoting chemical investigation.

The delivery of the address was frequently interrupted by applause, and Mr. Bell was rewarded with enthusiastic cheering on resuming his seat. Mr. Ladd then, by means of his beautiful apparatus and the electric light, exhibited a variety of spectra, illustrating the existence, in the stars and planets, of various metals, such as silver, copper, zinc, and the new metal thallium—which was discovered by means of the spectroscope. He also projected on the canvas a powerful electric light, and by means of a battery showed the colours of various chemical substances, and produced ozone.

Mr. GLOVER then proposed a vote of thanks to Mr. Bell for his able and exhaustive lecture. In past times, they had a Hutton, and a Bewick; and, in later times a Hugh Lee Pattinson, famous for his discoveries in the chemistry

of manufactures as applied to lead and the silvering process. They now had Mr. Bell, and as long as they had a gentleman among them capable of delivering an address such as they had heard that evening, they might rest assured that Newcastle would still retain her place in the world of science.

At the conclusion of the meeting a large number of the audience inspected the specimens on the table illustrative of the lecture, and the portfolio of photographs of the works of ancient masters executed by means of Mr. Swan's carbon process.

We hope to furnish our readers regularly with reports of the transactions of the new society.

FOREIGN SCIENCE.

PARIS, Jan. 20, 1869.

Estimation of Urea.—Experiments with Sulphuretted Hydrogen.—
Patent for the Extraction of Iodine.—Bleaching of Tissues.

SEVERAL errors are introduced in the estimation of urea when the nitrate of mercury used is prepared by acting upon the metal with nitric acid, the acidity of the titrated solution is variable, and the whole of the compound is not in the condition of mercuric nitrate. M. Byasson makes use of the following modification of Liebig's method:—Exactly 36 grammes of red oxide of mercury are weighed, and dissolved in 50 grammes of ordinary nitric acid diluted with half its weight of water; the solution is gently evaporated until acid vapours appear, and made up with distilled water to the volume of 1 litre, at about 15° C. If the dilution with water should cause a slight turbidity, a few drops of acid will render the solution clear. In this way a solution is obtained in which all the mercury is present as mercuric nitrate, and as little acid as possible. A test solution of urea is prepared by dissolving 20 grammes of crystallised urea in 1 litre of distilled water; 1 c.c. of the mercurial solution already made should correspond to .005 gramme of urea. During the process, M. Byasson makes use of a solution of 25 grammes of potash in 1 litre, from time to time, to partly neutralise the acid set free; the urea solution must never be rendered alkaline. The potash solution indicates the completion of the reaction, by forming a yellow precipitate on the surface. M. Byasson's results with this process agree remarkably well.

M. Böttger has made known the following experiments to be realised with sulphuretted hydrogen. A jet of this gas inflames by contact with tetroxide of thallium, peroxides of manganese and lead, as well as with the peroxide of silver obtained in powder by a battery. Many chlorates, iodates, and bromates behave similarly. Other compounds occasion a violent explosion, among these acetylide and fulminate of silver and iodide of nitrogen.

A patent has been granted to M. Lauroy for a new method of extracting iodine, and treating the salts derived from kelp. When the lixivium has been freed from the less soluble salts, and concentrated to a density varying between 45° and 55° Baumé, it may contain free alkali, carbonates, sulphides, sulphites, and hyposulphites of alkalies, as well as alkaline iodides and bromides. The treatment varies, according as it is desired to separate the salts contained, or to extract at once the iodine and bromine. When it is desired to extract the iodine and bromine at once, the liquid is saturated with hydrochloric acid; the deposit which forms is separated, and the gaseous mixture which is evolved in the reaction of nitric acid on organic matters (as in the preparation of oxalic acid, picric acid, &c.) introduced. When these gases are principally formed of binoxide of nitrogen, a quantity of air is admixed. The application of the nitrous gases may be made in several ways—sulphuric acid, in which nitrous gases have previously been dissolved, may be added to the liquid, or

when the liquor contains sufficient alkali, nitrous acid may be admitted as long as there is absorption, and any acid whatever added afterwards to precipitate the iodine. In whatever way one operates the precipitation of the iodine is determined by the reaction of the nitrous compounds. The precipitation is complete, and the bromine is not set at liberty. When the iodine has been thus separated, the mother liquor is submitted to treatment, and the bromine extracted by the ordinary methods.

Before giving an abstract of a memoir entitled "Researches on the Bleaching of Tissues," your correspondent would remark that the author is M. Kolb, not M. Kolbe. In the rough fibre of flax, there exist, along with cellulose, two distinct substances—the one, pectic acid, is abundant, and possibly completely eliminated by alkalies; the other is a colouring matter which is developed in the steeping. This substance tints the fibre grey, and resists alkalies, as well as all ordinary chemical solvents. It may be isolated by M. Peligot's ammoniacal copper solution. While the pectic products are abundant (15 to 36 per cent), the amount of the grey matter is infinitesimal. Chlorine water and dilute solutions of the hypochlorites decolourise this substance without dissolving it. After decolouration it is still insoluble in alkaline solutions, which remain colourless. When the three constituent parts of the fibre are separately submitted to the action of chlorine water, the following is the result:—(1) the grey matter alone is decolourised by very weak chlorine water; (2) in slightly stronger chlorine water the cellulose is disintegrated and then attacked, gradually passing into water and carbonic acid; (3) the brown pectic products are only decolourised by decomposition in very much stronger chlorine water, and long after the alteration of the cellulose. From this it results that, in bleaching, chlorine is necessary for the destruction of the grey colouration, while this reagent must not be reckoned upon for removing the yellow tint. Theoretically, perfect bleaching is reduced to two operations—(1) removal of all yellow colouring matter by rigorous exhaustion with alkalies; (2) oxidation, which simply decolourises the grey matter, but without rendering it soluble in lyes, as hitherto supposed. Chlorine water, oxygenated water, and ozone, dry or humid, effect bleaching; but is this phenomenon due to an absorption of oxygen by the colouring matter, or to a removal of hydrogen? Experiments show that there is absorption of oxygen. Chlorine water can only be employed without danger very dilute, and at the greatest strength marking 10 chlorimetric degrees. Oxygenated water only attacks the cellulose when very concentrated. With equal strengths, and immersion for the same time, chlorine has a much more destructive action, and, at the same time, a smaller bleaching power, than oxygenated water. In the same conditions, a solution of hypochlorous acid bleaches better, and alters infinitely less, than chlorine water; it is to some extent, an intermediate term between chlorine water and oxygenated water. Chloride of lime may be employed in three different ways in bleaching—viz., with hydrochloric, with carbonic acid, and simply in contact with the oxidisable matter. Of the three, the latter is the most rational, and presents most security. With regard to antichlors frequently employed, such as hyposulphite of soda, MM. Fordos and Gélis have demonstrated that if these substances remove, on the one hand, all trace of chlorine, on the other they favour the formation of acids pernicious to the cellulose. M. Kolb proposes to replace them by dilute ammonia, which acts first as antichlor in producing nitrogen and chloride of ammonium, and, further, removes, at the same time, all trace of acid from the tissue.

Certain fibres, perfectly bleached to all appearance, take, after a time, a yellow shade; this is only the case with those which have not been completely deprived of their pectic matters. M. Kolb has found ammonia in this respect a valuable reagent for detecting at once the possibility of this result taking place. All fibres which

have been bleached and rigorously deprived of pectose may be plunged in ammoniacal water with impunity; but if the exhaustion with lyes has not been complete, an amber tint will be immediately communicated.

NOTICES OF BOOKS.

Scientific Blue Books, No. II. Ninth Report of the Medical Officer of the Privy Council, with Appendix. London.

(Concluded from vol. xviii., p. 163).

A LARGE space has already been devoted to our abstract of Dr. Thudicum's original spectroscopic work, which we venture to say could not have been condensed further without serious loss; a summing up of the whole now remains. The reader who has followed the whole attentively, will find how gradually he has been led to a brilliant result in experimental science.

Attention has already been drawn to urocyanine, and its resemblance to indigo spectroscopically; as the interest centres here we will give the special features of its spectrum. The solution taken was 1 centimetre in thickness. Its colour and spectrum remained unchanged by the addition of some sulphuric acid. The intensity was about half saturation (as expressed in a diagram). After the solution had stood at rest for twenty-four hours, some blue matter had been deposited upon the sides of the glass, and the particular spectrum was replaced by an ordinary one. It was thus shown that the urocyanine is soluble in alcohol only in the nascent state, and soon becomes insoluble. Its quantity was so small, that beyond a test with nitric acid, which showed that it was destroyed, leaving some yellow colour, no further reactions could be made with it. Several other specimens of early urine of reaction yielded similar blue and purple matters, which also admitted of the identification of their absorption phenomena with those of the case of M. Willis.

As this same urocyanine has been described by some as indigo, the following conclusions are very valuable:—In the indigo spectrum the blue is, at all events, unaltered, and a blue cast is thrown over yellow and green. The spectrum of urocyanine shows no blue at all; at the end of green the spectrum is cut off; no manipulation, such as those related, can make it appear, no concentration of the indigo solution that allows the band to appear extinguishes the blue part of its spectrum. The proof that these bodies, if both are in a pure state, are not chemically identical, however related, is complete.

The colouring matter of bile has long been known to produce with nitric acid a blue colour among others, and as the reaction of cholera urine had in the Bavarian report been likened to this reaction of bile pigment, the following comparison was made:—An ammoniacal solution of cholephæine ($C_9H_9NO_2$) was treated with concentrated nitric acid until a blue precipitate was formed. This was quickly isolated by filtration, and after washing with water, dissolved in alcohol. It yielded a spectrum resembling that of indigo and also that of urocyanine. Important differences in the spectra, however, showed that indigo-urocyanine and cholocyanine are chemically different. Cholocyanine procured by the action, first of fuming sulphuric acid and subsequently of water upon cholephæine, showed an identity with ordinary cholocyanine. We are compelled to resist the temptation of following with our author the diagnosis of urocyanine from other important organic pigments or their products, but the omission of the note of myochrome as connected with these bodies in cholera patients would be inexcusable. It was found that the choleraic process had not changed the myochrome in its chemical composition; the identity of the spectrum of myochrome, which includes the identity of the chemical constitution of myochrome with that of hemochrome, was anew demonstrated.

The urocyanine of cholera urine is present in such small quantities that we can never hope to obtain insight into its composition and atomic weight by direct analysis; but the information wanted has to be obtained by syn- thetical comparisons similar to those of our author.

The following instructive list is given, when the ascertained spectra are arranged in the order of their succession from the red end towards the violet:—

Myohemine ..	142° 42'—142° 12'=0° 30'
Hemine	142° 36'—142° 6'=0° 30'
Urocyanine ..	142° 30'—141° 54'=0° 36'
Indigo	142° 24'—141° 48'=0° 36'
Urorubine ..	142° 24'—141° 54'=0° 30'
Hematine ..	142° 18'—141° 48'=0° 30'
Cholocyanine ..	142° 6'—141° 48'=0° 18'
Cyanine	142° 12'—141° 20'=0° 42'

The last-named body, a double base, obtained from animal oil, but containing iodine, possesses a spectrum which in several respects resembles the spectra below which it is ranged for the purpose of illustration and comparison. The alcoholic solution has the same purple blue colour as urocyanine, but, unlike this latter, it is easily and rapidly discoloured by acids. Like indigo it has the blue part of the spectrum bright and fully developed, and differs by this peculiarity from urocyanine and the hemochrome products.

"I have compared many more substances with those above mentioned. Organic colouring matters, particularly some from plants, yield spectra much resembling the hæmatic series, e.g., tincture of privet berry, which gives almost the hæmatine spectrum. Inorganic bodies, such as oxalic solution of Prussian blue, yield no separate bands, but peculiar absorptions, particularly of the red end of the spectrum. As these researches fail to throw any further light upon the particular point here enquired into, they cannot be here related."

Since this report was issued, in the *Journal für Practische Chemie* of last July, Dr. Thudicum has made further remarks on the colouring matters of urine and on uromelanine, a decomposition product of urochrome. It is well known to physiologists that every colouring matter in the human economy has at least four or five different names, the x chrome of one author may equal the x xanthin of another, or the y chrome of a third with any number of permutations. If Dr. Thudicum would give to the world his coloured spectroscopic plates and his last researches, retaining his nomenclature, in one volume, the slough of despond would be crossed by a railway, by which all could travel with a chance of finding both termini, not the one of departure only.

We strongly urge, then, the want of an arrangement upon an accurate basis, including the last results of these pigments; if Dr. Thudicum does not care to face such a task, we know of no substitute for him. In default, the medical jurist and the pathologist must feel a debt of gratitude to the Government for this most valuable report afforded for their use.

CORRESPONDENCE.

THE COHESION FIGURES OF LIQUIDS.

To the Editor of the Chemical News.

SIR,—I had the pleasure, last night, at the *soirée* given at King's College, of seeing Professor Woodward work the apparatus (contrived by him and described at p. 21 of your journal) for showing the cohesion figures of liquids on a large scale to an assembly of persons.

The apparatus answered its purpose admirably. It is simple in arrangement and easy to manage. The water surface, 3 inches in diameter, on which the drops are deposited and the figures formed, is quite accessible, and nearly as easy to work with as the water in my shallow

glasses 4 inches in diameter. The heat of the lamp has an effect on the water, and allows the development of figures on the smaller scale which would probably not take place at ordinary temperatures. The screen, 5 feet in diameter, is well filled and the definition good. Some of the figures are a little too faint, owing to the great expansion and the brightness of the light, and for similar reasons, colour, which is so charming a feature in many of the figures, is wanting.

The figures shown on this occasion were those of only a few liquids, viz., creosote, a mixture of equal parts carbolic and cresylic acids, benzol, oil of lavender, and a solution of camphor in benzol. I am satisfied from what I saw that the figures of a large number of liquids might be exhibited with ease and in rapid succession, provided the lecturer was assisted by persons who understood the conditions of the illustrations. I may, perhaps, be pardoned if I state briefly what these are, as success or failure will very much depend on the mode in which these conditions are observed.

The most essential condition in the production of these figures is chemical cleanliness. To insure this, one water recipient (No. 1) (marked B in the figure, page 21, *ante*) ought to be in process of cleaning; a second (No. 2) ought to be clean, and filled with water, while the third (No. 3) is on the point of being removed from the apparatus. Thus there ought to be three water recipients in use.

Next, as to the mode of cleaning. As soon as No. 3 is removed from the apparatus its contents are to be emptied into a waste pan, and clean water poured over it from a jug into the pan. It should then be filled with a moderately strong solution of caustic potash, which is not to be thrown away, but poured into a reserve potash jar. (A quart Phillips's jar with a funnel in the mouth is a convenient receptacle for the potash solution). When the water recipient, No. 3 has thus been washed with potash, it should be again rinsed with water, and, lastly, filled with clean or distilled water from a bottle—not from a washing bottle by means of a blowing tube, but simply from a clean bottle, which is to be kept closed when not in use. In filling No. 3, it may be placed on a clean cloth or flat surface of sponge, so as to dry the flat bottom surface. By this time No. 2 is resting on such a surface ready to be transferred to the apparatus, and No. 1 is in process of cleaning. In this way there need be no delay in producing the figures, and the lecturer will be able to resist the temptation, should a drop fail to spread, of waiting in hopes it will do so, or of trying another liquid on an already impure surface.

Next, as to the method of delivering the drops to the surface of the water. It is commonly supposed that provided the drops reach the surface it does not much matter how. They are generally allowed to fall upon the water. This is quite wrong, and may be a source of frequent failure. A distinct drop should be gently delivered to the centre of the water from the end of a glass rod, with a steady hand and the absence of every kind of disturbance. In this way we get symmetrical figures of great beauty. The glass rods, when not in use, should be kept in a solution of caustic potash. When one is taken out it should be passed through clean water with a brisk stir and then wiped in a clean cloth. It may now be dipped into the oil, &c., and the liquid left to drain, until it is seen that a distinct drop can be fairly delivered. The rod is now to be wiped in a dirty duster (No. 3), then in a moderately clean duster (No. 2), and, lastly, in a clean duster (No. 1) before returning it to the potash solution.

Pipettes and dropping tubes should only be used for ether, alcohol, and those liquids of which the figures have a short duration. A drop being delivered to the water surface, the hand should be removed for a moment, to allow an uninterrupted view on the screen, but the moment one figure has vanished another drop should be deposited on the surface. In this way a perfect idea of the figure will be gained from a succession of optical images.

By a judicious use of the caustic potash solution the

apparatus can be kept in good working order; but after using oils for some time the water vessels, glass rods, &c., require to be washed in strong sulphuric acid and well rinsed. The lecturer will soon find out for himself when this is necessary.

Another source of failure in the production of these figures lies in the impurity of the figure-producing liquid. One of the most difficult figures to produce is that of oil of lavender (it was admirably shown by Professor Woodward's apparatus): one reason is that this oil is so commonly adulterated with oil of turpentine; another that the oil becomes partially resinified by age. The figure, produced last night, was from a Mitcham oil about eight years old, re-distilled by me nearly three years ago. I have several specimens of these oils of different ages; they all give good figures, but some foreign oils that I have by me produce nothing but disappointment.

Solid carbolic acid in small fragments, rotates on the water surface with immense velocity, after the manner of camphor. (Camphor also may be tried, but the fragments should be scraped from a freshly cut surface with the point of a pen-knife). If a needle of the commercial acid be placed on the water, it darts about, suddenly, liquefies forms into a disc from which angry-looking waving forked tongues proceed, and so it wastes away. If the liquid acid be used, care must be taken to deliver it gently to the surface, or it will slip through and form an inert globule at the bottom of the water.

Carbolic acid, or a mixture of this and cresylic acid, forms an active vigorous figure, and if a drop be placed on the same surface with what is left of the lavender figure, the mutual attractions and repulsions form a surprising sight.

Cresylic acid leaves delicate silvery flakes on the surface of the water, and in this way the presence of a few drops per cent of this acid in carbolic acid can be detected.

I intended to have given a list of liquids likely to form good figures before an audience, but as this letter is perhaps already too long, I must defer doing so.—I am, &c.,

C. TOMLINSON.

Highgate, N., Jan. 15, 1869.

ON THE ARTIFICIAL FORMATION OF "ATACAMITE."

To the Editor of the Chemical News.

SIR,—In the *Journal of the Chemical Society* for this month, p. 24, Mr. Church, in continuing his mineralogical notices, states that in 1864 he commenced a series of experiments upon the action of salt on "chessylite," whereby he hoped to elucidate the formation of atacamite when sea water acts on copper ores. The author continues "the only really successful experiment was one in which the following substances had been placed together:—200 c.c. of a 10 per cent solution of salt gave 2 grammes chessylite."

The word *gave* is doubtless the printer's error. The sentence should read, I imagine, "200 c.c. upon 2 grammes chessylite."

Mr. Church further says, "the blue colour of the finely powdered chessylite slowly disappeared, a pale green tint taking its place, while at the same time the saline solution became notably alkaline from the conversion of the sodium chloride into carbonate. In the following table the composition of chessylite, of its chlorinated product, and of atacamite, are compared together:—

	Chessylite.	Chlorinated Product.	Atacamite.
CuO	69.2	59.55	53.6
CO ₂	25.6	—	—
H ₂ O	5.2	18.14	16.2
Cu	—	10.47	14.3
Cl	—	11.70	16.0

This experiment recalls some researches of my own made as far back as September, 1858, and published in the *Chemical Gazette*, vol. xvi., p. 430, wherein it is stated that the oxide of copper mechanically brought over by the draft from the calcining furnaces into a culvert running along the shore of the Pacific Ocean, the floor of which was composed of sandy rock through which the sea water permeated, became, after some months, entirely converted into the sulphates and oxychlorides of the metal. After separation of the former, the oxychloride was found to have the following composition:—

Cu	56.92
Cl	16.30
HO	16.14

or—

CuO	53.11
CuCl	30.73
HO	16.14

leading to the formula, $3\text{CuO}, \text{CuCl} + 4\text{HO}$. Native atacamite gives—

Cu	57.13
Cl	16.07
HO	16.07

More than 8 tons of atacamite were thus obtained.—I am, &c.,

FREDERICK FIELD, F.R.S.

HOUSEHOLD POISONING: THE TINNING OF SAUCEPANS.

To the Editor of the Chemical News.

SIR,—In connection with the extract inserted in the *CHEMICAL NEWS* of the 11th ult., on “The Tinning of Saucepans,” I hope you will consider the following worthy of space in your valuable columns:—

For some few months my wife, children, and self suffered exceedingly from pains in the stomach and bowels, accompanied by diarrhoea. A sustained contest was kept up between medicine and illness, in which the latter was certainly becoming victorious. Ultimately, on account of defeat, my wife's medical attendant stated substantially that her symptoms were peculiar and unaccountable. This assertion excited my suspicion that her sufferings resulted from poisoning. Being most fortunately a chemist, I at once secured what were at hand to test for poisons; they were—1 pint of toast water, about 1 pint of tea (the remains of my own breakfast), and a pint of drinking water. The three fluids I mixed, strained, tested carefully, and analysed; and, I may add, was horrified, as well as gratified, to find an enormous quantity, comparatively speaking, of both copper and lead. Eliminative remedies were promptly administered. For two days my wife continued to progress slowly; the morning of the third day from the detection of the causes of her illness she strongly perceived a disgusting metallic or coppery taste, her gums were discoloured and painful, and she sank into a state of collapse, in which apparently hopeless condition she remained for three and a half hours. To the credit, however, of medical skill as a means, she was rallied, has continued to progress, and is now almost wholly recovered. Previous to sinking into this state, she had vomited nearly half a wine-glassful of a beautiful bright saffron-coloured fluid, which I kept, and in which I found a notable quantity of copper and lead, as well as a remarkable proportion of iron and magnesium phosphate; the iron was derived from the mains through which the water is supplied and the cooking utensils, and the magnesium phosphate from toast-water.

Now with regard to the tinning of saucepans; these, I regret to say, are not the only tinned cooking utensils. Here in the north of England, and, I believe, throughout the United Kingdom, there is nothing more common in an ironmonger's shop than pots, pans, kettles, &c., lined with this beautiful but dangerous metal. I know doctors do

not generally condemn it as such; I must, however, respectfully differ from them. I presume their reason for permitting its use is the fact of air and water but slowly acting upon it at ordinary temperatures; boiling, stewing, and roasting, however, are not ordinary temperatures—nor are the fluids heated therein, as a rule, free from acids. Moreover, through negligence or ignorance, cooks partially fill vessels lined with this substance, and place them on fires which speedily evaporate or boil down the contents. The flames now wrap the vessels, elevating the temperature of the exposed tin, whereby it is rapidly oxidised. If not oxidised thus quickly, it is soon dissolved by the liquors with which it is heated. When tin is received into the stomach it at once comes into contact with the gastric juice, which contains free hydrochloric acid, with which it combines, forming a most irritant poison.

Another most serious objection to the use of tinned vessels is the admixture of lead mentioned in the extract above referred to. About two months since, when investigating the cause of my family's sufferings, I found in my house a small tinned pan; the tinning of this vessel yielded on analysis over 18 per cent of lead. Nearly the whole of the tin had disappeared from the sides; two small lumps of alloy of it and lead remained at the bottom. I have since examined several tinned pots, &c., which had been in use for twelve months, and found them in an almost identical condition; they caused a great deal of illness, and had to be rejected. The fact of tin being almost completely removed from the sides is a practical proof, if such be necessary, of the oxidation and solution before mentioned. Now I submit that copper, brass, and tinned vessels for the preparation of food can and ought to be discarded. Those made of iron, or iron porcelain-lined, would be uninjurious and excellent substitutes. There are at present many victims to diseases the cause of which they are completely ignorant of, but which could be truthfully charged to brass, copper, and tin. Doctors are defeated and discouraged, and numbers die annually whose lives might be saved by the disuse of poisonous metals for domestic purposes. If chemists of repute or status would bring this serious subject somewhat prominently before medical gentlemen, the latter would not be slow to adopt valuable suggestions, and their instructions to patients, without the aid of law (as in France and Prussia), would compel manufacturers to desist from producing articles for which there would be no demand. I trust the gravity of the subject will be a sufficient plea for asking you to insert this rather lengthy letter.—I am, &c.,

J. C. LEE.

MISCELLANEOUS.

American Institute.—The following lectures are in course of delivery at the American Institute:—

Dec. 30, 1868.—Mr. James Hall, State Geologist, Albany; “On the Evolution of the North American Continent.”

Jan. 6, 1869.—Prof. Horsford, Cambridge, Mass.; “On the Philosophy of the Oven.”

Jan. 13.—Dr. T. Sterry Hunt, Montreal, Canada; “On Primeval Chemistry.”

Jan. 22.—Prof. Doremus, College of the City of New York; “On the Photometer.”

Jan. 27.—Mr. Waterhouse Hawkins, of London; “On Comparative Zoology.”

Feb. 3.—Prof. Cooke, Harvard College, Mass.; “On the Spectroscope.”

Feb. 10.—W. J. McAlpine, Pres. Am. Soc. of C. E.; “On Modern Engineering.”

Reports of those lectures most interesting to our readers will appear in our columns.

The Solar Protuberances.—M. Janssen has forwarded a letter from Simla (Himalaya) to the French Academy of Sciences in which, after giving further particulars respecting his discovery of the visibility of the spectra of the protuberances in full sunshine, he describes an ingenious plan by which he expects to be able to see the actual protuberances themselves at any time. The principle consists in getting one of the luminous lines in the spectral field, and then rapidly rotating the spectroscop. As the length of the luminous line depends upon the height of that part of the protuberance which it represents, it is evident that the rotation will cause the line to vary with the different widths of the protuberance, and if the rotation is sufficiently rapid, the permanence of the impression on the retina will produce an accurate representation of the protuberance under examination.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Comptes Rendus.

October 26, 1868.

J. JAMIN, "On a Differential Refractor for Polarised Light." A. GIRARD, "On a New Volatile and Saccharine Principle Discovered in Caoutchouc from the Gaboon." A. BECHAMP, "On the Decomposition of the Sulphides of the Alkalies and Alkaline Earths by Solution in a Large Quantity of Water." WARREN DE LA RUE, "On the Method employed by J. N. Lockyer for obtaining Spectra of the Protuberances observed during Total Eclipses of the Sun." JANSSEN, "Note on some Results of the Author's Observations of the Total Eclipse of the Sun of August, 18, 1868, at Guntoor, India." FAYE, "Note à propos of the Two preceding Papers." BERTHELOT, "On the Formation of Homologues of Benzene by the Reciprocal Action of Free Hydrocarbons of more simple Structure. On the Carbonaceous Matter contained in certain Meteorites."

November 2, 1868.

DELAUNAY, "On the Discovery of a Method of Observing Solar Protuberances at all times." E. PELIGOT, "On the Composition of the Chromites of Iron." S. MEUNIER, "Analysis of a Meteorite." C. MARIGNAC, "On the Latent Heat of Volatilisation of Sal-Ammoniac." F. JOLYET and A. CAHOURS, "Researches on the Physiological Action of Methyl-Strychnine and Ethyl-Strychnine." C. GLASER, "On Acetenyl-benzene, a new Hydrocarbon of the Aromatic Series." S. DE LUCA, "Chemical and Therapeutical Researches on the Waters of the Solfatara of Pouzzoles." E. GILLES, "A Method of Classifying the Elements based upon their Chemical Equivalents."

Bulletin de l'Académie Impériale des Sciences de St. Petersburg.
August 12, 1868.

F. BEILSTEIN and A. KÜHLBERG, "On Substituted Alcohols and Aldehydes." E. NEUHOF, "On some Derivatives of Para-Chlorbenzyl Alcohol." J. FRITZSCHE, "Researches on Hydrocarbons." N. ZININ, "On a Product of the Action of Hydrochloric Acid on Essence of Bitter Almonds containing Hydrocyanic Acid."

Annalen der Chemie und Pharmacie.

October, 1868.

R. FITTIG and J. VELGUTH, "Researches on Mesitylene. Fifth Memoir: On Isoxylol, a new Hydrocarbon Isomeric with Xylol." L. BARTH, "Researches on Oxybenzoic Acid. Note on a Compound of Phenol with Carbonic Acid." L. CARIUS, "A new Synthesis of the Aromatic Acids." A. STRECKER, "On Lecithine. On a new Mode of Formation and on the Constitution of Sulpho-Acids." K. BENDER, "On a new Mode of Formation of Sulpho-Ethyl and Disulpho-Ethylenic Acids." A. COLLMAN, "On a new Mode of Formation of Sulpho-Methyl, Isethionic, and Sulpho-Acetic Acids." A. SCHAUFFELE, "On the Sulpho-Acids of Glycerine." L. DARMSTADTER, "On the relative Constitution and on some Metamorphoses of Epichlorhydrin."

Monatsbericht der Königlich Preussischen Akademie der Wissenschaften zu Berlin.

July, 1868.

E. WIEDEMANN, "On the Magnetism of Chemical Compounds." A. W. HOFMANN, "Contributions to the Knowledge of Guanidine. Compounds Isomeric with the Sulphocyanic Ethers.—II. Homologues and Analogous of Ethylic Mustard Oil."

Journal für Praktische Chemie.

October 17, 1868.

G. WERTHER, "An Analysis of the Meteorite which fell at Pultusk, Russian Poland, on the 30th of January, 1868." J. LOWE, "On the Preparation and Composition of Catechuic Acid."

MEETINGS FOR THE WEEK.

MONDAY, 25th.—Medical, 8.

London Institution, 6.

TUESDAY, 26th.—Royal Institution, 3. Mr. Westmacott, "On Fine Art."

WEDNESDAY, 27th.—Geological, 8.

Society of Arts, 8.

THURSDAY, 28th.—Royal Institution, 3. Prof. Rupert Jones, "On Entozoa."

Royal, 8½.

Zoological, 8½.

FRIDAY, 29th.—Royal Institution, 8. Mr. Ruskin, "On the Flamboyant Architecture of the Valley of the Somme."

SATURDAY, 30th.—Royal Institution, 3. Dr. Odling, F.R.S., "On Hydrogen and its Analogues."

NOTES AND QUERIES.

Ice House.—Will any person acquainted with the subject, kindly furnish me with a description as to the best method of constructing an ice house on a small scale?—ZERO.

Dynamite.—Your correspondent, Mr. Wheeler, will perhaps be glad to learn that dynamite may be obtained from Messrs. Webb and Co., Carnarvon, N. Wales, the sole consignees in England from the patentee and manufacturer.—ALPHA.

Separating Iron and Brass Dust.—We wish to know the name and address of the patentee (or the maker) of an electro-magnetic apparatus for separating iron from brass dust. The name of any firm using one will answer our purpose as well, as we wish to make enquiries as to the capabilities of the apparatus.—HIBBERT & Co.

TO CORRESPONDENTS.

* * * VOL. XVIII. of THE CHEMICAL NEWS, containing a copious index, is now ready, price 11s., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes, are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xix. commenced on January 1st, and will be complete in twenty-six numbers. It will contain a verbatim report of Dr. Odling's Juvenile Lectures at the Royal Institution "On the Chemical Changes of Carbon," and original papers from some of our leading English and Foreign Chemists and Physicists.

C. R.—To ascertain the composition of the substance forwarded to us would involve a chemical analysis.

S.—1. Apply to Messrs. Johnson and Matthey. 2. Consult O'Neill's "Dictionary of Calico Printing."

Per Mare Per Terram.—An "assay centner" is an indefinite technical term. It means 100 units of weight. In copper assays, for instance, the centner is frequently 400 grains.

T. Thompson.—Phosphate of lime is decomposed by ebullition with an aqueous solution of oxalic acid. Probably this reaction will be of use in your research.

A. M. Edwards.—1. The presence of alkali prevents iron from rusting, and this fact is frequently made use of, but we have not seen any satisfactory explanation of the circumstance. 2. Thallium and its salts can be procured from Messrs. Hopkin and Williams, New Cavendish Street, London, W. 3. There is only one copy of vol. ix. at our office; its price is 30s.

G. F. R., and others.—It is gratifying to know that the alteration of type which we have introduced with Dr. Odling's Lectures gives such satisfaction. The fount, which has been specially cast for us, is particularly legible, retaining all the picturesque quaintness of antique style with the mathematical accuracy which characterises modern type.

Communications have been received from Professor Wanklyn; R. Mallet, F.R.S.; W. T. Suffolk; E. Stanton; Professor A. M. Edwards, New York; W. Little; Hibbert and Co.; E. P. H. Vaughan; J. Salter; J. Spiller; M. L'Abbé A. Hamy; G. Keyworth; E. Pocknell; Messrs. Townsend and Adams; E. W. Ball; J. F. Dickson; C. K. Jewett, Göttingen (with enclosure); B. Sulman; J. J. Ward (with enclosure); J. Solomon; B. Nickels; Gaskell, Deacon, and Co.; G. F. Rodwell; J. Hughes; T. Ludwig, Suez, Egypt; W. M. Watts; Professor Rudolph Fittig (with enclosure); and Dr. S. Muspratt.

BOOKS RECEIVED.

The Photographic Journal, No. 201, vol. 13.

Report of Annual Meeting of Members of the Lincolnshire Farmers' Association.

Van Nostrand's Eclectic Engineering Magazine, No. 1 vol. 1.

THE CHEMICAL NEWS.

VOL. XIX. No. 478.

ON THE CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(ADAPTED TO A JUVENILE AUDITORY),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN,

(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, Esq., M.B., F.R.S.

(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE III.

AIR—OXIDES—CARBON OR CHARCOAL.

Unabsorbed four-fifths of original air known as phlogistic air, or nitrogen; its capability of supporting combustion and life—Recovery of absorbed one-fifth of air, by heating the rust of mercury—Proportion of ordinary air absorbed by rusting mercury, and evolved by ignition of the rust, known as vital air, or oxygen; its extreme power of supporting combustion and life—Reproduction of ordinary air by admixture of vital air, or oxygen, with phlogistic air, or nitrogen—Formation of oxides by combustions of different substances in air or oxygen—Formation of arsenious acid or oxide, by combustion of arsenic; of carbonic acid or oxide, by combustion of carbon; of sodium oxide or soda, by combustion of sodium—Oxidation of carbon by its ignition with arsenious acid, and correlative deoxidation of the arsenic—Oxidation of sodium by its ignition in carbonic acid gas with correlative deoxidation of carbon or charcoal—Existence of carbon, or charcoal, in burnt or oxidised, and in unburnt or unoxidised condition—Presence of charcoal in any combustible shown by occurrence of carbonic gas, or oxide of carbon, as a product of its burning—Presence of hydrogen in any combustible shown by occurrence of water, or oxide of hydrogen, as a product of its burning—Presence of both carbon and hydrogen in coal-gas shown by occurrence of both carbonic gas and water as products of its burning—With deficient supply of air, preferential burning of the hydrogen of coal-gas, and partial separation of its carbon—Separation, also, of the carbon of coal-gas as a result of its ignition, or simple exposure to a red heat—Ordinary production of charcoal from wood, peat, &c., by the processes of partial burning and of ignition respectively—Unburnt carbon the characteristic constituent of vegetable tissue—Passage of unburnt charcoal from the vegetable into the animal and mineral kingdoms—Manufacture of animal charcoal, or bone-black, and of mineral charcoal or coke—Remarkable porosity of certain kinds of charcoal—Extraction from boxwood charcoal of many times its volume of air; absorption by boxwood charcoal of fifty-five times its volume of sulphuretted hydrogen gas, and ninety times its volume of ammonia gas;

* Reported verbatim, by permission of the Author, for this Journal.

yet greater absorptive power of cocoa-nut shell charcoal—Chemical reactions on each other of different gases absorbed into charcoal—Absorption and aerial oxidation of putrefactive vapours by charcoal—Principle of charcoal ventilators, charcoal respirators, &c.—Absorptions of different colouring and odorous matters from solution by charcoal—Purification of water by charcoal filters, with destruction as well as absorption of impurities.

You will remember that when charcoal or carbon burns in air it is changed into carbonic gas; we have now to consider what is the nature of this change—what it is that happens to the charcoal, and what it is that happens to the air in which the charcoal burns.

In order to find out what occurs to the air we must first know a little more about the air, and particularly whether ordinary air, in which the combustion of charcoal and other combustibles takes place, consists of one kind of air only, or is a mixture of two or more different kinds. You will remember that all kinds of air are miscible with each other; in this respect, they differ from liquids, and accordingly we have this morning to begin our consideration of the question whether air consists of one kind of air only or of two or more different kinds. But first I want to direct your attention for a moment or two to an experiment which, as it takes some little time, I will now commence, and in half an hour we shall, perhaps, see the result.

Here I have an ordinary transparent glass tube, which is filled with pieces of broken white porcelain, and through this tube I am going to pass a current of ordinary coal gas. The coal gas is now passing through the tube; we will just let it blow out the air with which the tube was first filled, and then we will apply a light to it. Now you observe that the tube is filled, and that the gas burns in the ordinary way in which coal gas burns; gas is passing through the porcelain, but it does not now produce any effect. I am going to repeat this experiment with this difference—that the tube instead of being cold will be made red hot, and after the porcelain has been heated sometime in the furnace we shall see whether it has undergone any change. [Near the close of the discourse, the lecturer again drew attention to this experiment, and pointed out that, under the influence of the strong heat which had been applied to the tube, the coal gas had deposited a portion of its carbon; the separation of the carbon being evidenced by the blackening of the porcelain.]

We will now proceed to the consideration of the nature of ordinary atmospheric air.

When a body—iron wire, for instance—rusts in the air, this is the sort of thing that occurs. If you take five measures of air, and put the iron wire into them; they grow gradually less and less in bulk; a portion of the air becomes ab-

sorbed by the iron wire until a certain point is reached when exactly one-fifth of the entire quantity of air has been absorbed, and when this has taken place, the rusting action ceases. The absorption goes on no longer, but the remaining four measures of air are of a very different character from the original five; metals will no longer rust in them, bodies will no longer burn in them, and animals will no longer breathe in them. Apparently, therefore, the whole of the gas which enables metals to rust, combustibles to burn, and animals to breathe, exists in the one-fifth of the volume of air taken up by the rusting wire.

Now let us pass to the burning of a body. If we burn, in a confined volume of air, some highly combustible substance, such as phosphorus or sulphur, the same thing takes place. The phosphorus goes on burning, and as it burns the volume of air gets less and less, until exactly one-fifth part of it has disappeared, and as soon as one-fifth is consumed the phosphorus is extinguished; it no longer burns, and we get exactly the same kind of air as in the other case. Of our original five volumes of air, we have four remaining, and in these, metals will no longer rust, combustibles will no longer burn, and animals will no longer breathe. If, instead of burning a highly combustible body like phosphorus, we take one less so, such as a candle, we find that it is extinguished before one-fifth part of the air has been taken up; but if we then introduce some iron wire it will rust and take up a further portion of the air, and when the iron wire no longer rusts in it we shall find that the quantity of air taken up by the candle, supplemented by the remaining portion taken up by the rusting of the wire, amounts to exactly a fifth part of the original volume. Again, if we put a bird or a mouse into a vessel of air, it would go on breathing whilst our air became less and less, but it could not go on until it had entirely taken up the fifth part of the original air. These animals are, in this respect, in the condition of the candle; but if we take some slow breathing animals, such as snails or frogs, and put them into a confined quantity of air, they will do exactly what the burning phosphorus does—they will go on breathing until they have consumed the fifth part of the volume of the original air, and they will leave four volumes of air of the same character as that left by the burning phosphorus, in which metals will no longer rust, combustibles will no longer burn, and animals will no longer breathe.

Now comes the question—what is the nature of these remaining four volumes of air? Chemical experiments tend to prove that they are of the sort to which the Greek name of *azotic* or lifeless air was given. It was also called by another name, equally long, and far

more barbarous—*phlogistic* air. It has also received the name of *nitrogen* gas, by which it is generally known. Here is a bottle of nitrogen; we introduce into it a lighted taper, and it is immediately extinguished.

Now is it possible to recover this one-fifth part of the air which has been absorbed? Yes, it is; and it is interesting to note that the particular experiment by which the composition of air was first ascertained by Lavoisier is the same which still best serves to exemplify its composition. I have spoken to you about the rust of iron. Chemists are acquainted with a great number of metals, and in particular with that metal which you see in this bulb, and which you know as quicksilver or mercury. It is a very peculiar metal, and the only one which is in a liquid state at the ordinary temperature. You know that lead, for instance, is solid at the ordinary temperature, but it will become liquid upon being heated, and even iron and gold when very intensely heated also become liquid. Mercury, however, is hot enough at common temperatures to exist in the liquid state, and it is the only metal with which chemists are acquainted that is so. At the ordinary temperature, whether in summer or winter, and in any climate, mercury does not rust. It only rusts when heated, and then it does so very quickly, and meanwhile maintains just the same sort of action as the iron does. As it rusts it absorbs one measure out of the five measures of air, and we obtain, as the result, a quantity of the rust of mercury, which is a red substance not unlike the rust of iron. This bottle contains some of it; it was made by rusting mercury in heated air.

There is another point of interest in connection with this rust—if you go on heating it still more strongly the mercury which had become converted into rust, makes its appearance again in the original state, and at the same time a quantity of air or gas is given off, the peculiarity of which is that the amount of gas so evolved is exactly the quantity of air or gas which the mercury absorbed in rusting; so that if you take five measures of air and heat the mercury in them, and so absorb one measure, and then take the rust of mercury so produced and re-heat it, you recover exactly the one measure of air which the mercury originally absorbed. Here is the experiment arranged in this small tube. We have in the tube some of the rust of mercury. We will heat it rather strongly, and in the course of a little while we shall find that it will break up into the original mercury, and into a certain quantity of air or gas, which, in a few minutes, we will collect in this receiver, in order to ascertain its nature. This substance will take some little time in becoming sufficiently hot, because, after it is heated to the temperature at which mercury

rusts, it must be heated to a degree beyond, that it may undergo this decomposition into the original mercury and into the gas. [After an interval]—Our decomposition has taken place in the tube. The vital air is now being given off by the action of heat, and in the upper part of the tube we have the mercury in a separated state. I will just show you what is the nature of the air which we have in our tube—even this small quantity will suffice for our purpose. We introduce a match into this vessel, and you see how very brilliantly it will burn in the vital air from the rust of mercury.

We will now consider what are the properties of this particular kind of air; it has *this* property—that if you take the one measure of air which the mercury first absorbed in order to rust, and add it to the four volumes of air that remain, you get exactly the quantity with which you started—viz., five volumes; and more than that, these five volumes so formed are undistinguishable, by any means whatever, from the original air with which you began the experiment. Now you will remember that this nitrogen—this residual air—is a kind in which bodies will not rust, nor combustibles burn, nor animals breathe. The breathing capabilities all lie in the one-fifth part which becomes absorbed. Then comes the question, what name shall we give to this one volume upon which the breathing power of animals is exercised? It was originally called *vital air*—and formerly all these different kinds of gases were called *airs*; this *vital air* is now known as *oxygen gas*.

Now, from what we have observed in the experiments which have been explained to you, we learn that atmospheric air is a mixture of four volumes of phlogistic air, or nitrogen, with one volume of vital air or oxygen; at any rate, this may be taken as about the proportion between the two. It is not exactly correct; the actual figures are—79 parts (instead of 80) of nitrogen, and 21 parts (instead of 20) of oxygen, to make up 100 parts of ordinary atmospheric air; this, then, is the composition of the atmosphere.

I will now proceed to direct your attention to some of the properties of oxygen. You will remember that in my former lecture I called to your minds the fact that, in addition to ordinary combustibles, such as candles, coals, and gas, chemists are in the habit of regarding different metals as combustible bodies; and I showed you how magnesium and zinc might be burnt in air. Now I wish first to direct your attention to the manner in which iron may be burnt in air, and then to the way in which it may be burnt in oxygen.

We will first burn some iron in air, and for that purpose we must employ a current of air,

and also have our iron in a very fine state of division—viz., in filings; for you know that iron in a large mass, such as a poker, will not burn in air, but in the state of filings, you will see that it will do so, and with very considerable brilliancy. [Steel filings were showered upon a large flame from a gas blowpipe, and burned with their well-known star-like effect.] You see that in this way iron may very readily be burnt in ordinary air. Now I want to call your attention to the very different manner in which it burns in oxygen gas. When we burnt it in the air it was in the form of filings, but we can burn it in oxygen in a much larger mass. We take just such a flame as we had in the last experiment; but, instead of it being supplied with a current of air, as the other was, it is supplied with a current of oxygen gas, and in this we will now try to burn a piece of iron. For this purpose, we will take an old knife, and see what will happen. [A portion of the knife-blade was speedily consumed in the flame, and the combustion was attended by copious scintillations.] Well, you see it is very fortunate (if the expression is a correct one in such a case) that our atmosphere does not consist entirely of oxygen; for if once these knives got thus heated they would burn almost entirely away, and we should have none for use. So much, then, for the manner in which bodies burn in oxygen gas compared with the way in which they burn in ordinary air.

We will now endeavour to burn another metal in oxygen, and it is one with which you are not quite so familiar. There is a piece of metal in this tube; we apply heat to the tube, and the metal will very soon be hot; you will then see it burn in the oxygen gas which we now pass through the tube. We will have the lights lowered that you may see the very beautiful appearance it presents when burnt under these circumstances. It is just beginning to take fire, and now you see it burning with great brilliancy. The metal upon which we are now experimenting is arsenic, and by burning it we have produced a compound of the metal with the oxygen in which it burned, and this compound is oxide of arsenic, or the ordinary white arsenic of the shops. Now, having burnt this substance—arsenic—we are next going to do the same with charcoal. We have some in this dish, and the first thing we must do is to ignite it. You remember that when charcoal burns in oxygen it forms carbonic gas, and this carbonic gas is an oxide of carbon, just as the white arsenic which we formed by burning arsenic in oxygen was an oxide of arsenic.

Now, if instead of burning the charcoal in oxygen, we burn it in the white arsenic, the oxygen, under those circumstances, would leave

the arsenic in order to burn the charcoal. The charcoal is burnt into carbonic gas, and the white arsenic is correspondingly unburnt into metallic arsenic. Here is the experiment already performed. We had here a mixture of white arsenic and charcoal; the charcoal took away the oxygen from the arsenic, and burned in that oxygen, consequently the arsenic is deposited in a metallic state in the form of this black ring.

I will now show you the combustion of one other metal in oxygen—sodium—and while it is burning I will again have the gas-lights lowered, and ask you to look at the appearance which the various colours upon this diagram exhibit when they are illuminated by the sodium light; and now compare the appearance of those colours under the sodium light with their present aspect in the bright light afforded by the burning of the metal magnesium. Now, when the sodium burns in oxygen it forms soda, or oxide of sodium. What then takes place with the sodium, when instead of burning in pure oxygen, it burns in carbonic gas? Just what I showed you in the first lecture. It burns in the oxygen which is already combined with the carbon; it takes away the oxygen from the carbon, in this way setting it free, just as when the charcoal burnt in the oxide of arsenic it took away the oxygen of the oxide of arsenic, and set free the arsenic in the metallic state.

(To be continued).

Researches on Trimethylbenzine.—This product is obtained by synthesis from xylene and toluene, and the substitution and oxidation products of this compound have been examined. In the same research the presence of mesitylene in mineral pitch, and its production, by the action of liquid chloride of zinc on camphor, is shown.—*Nouv. de Göttingue.*

A New Ventilator.—M. Damboise-Bénard has designed and patented an apparatus for increasing the draught in chimneys, and promoting ventilation. The apparatus consists of a hood, which is placed on the top of the chimney; this hood is movable—that is to say, it rotates upon an axis. In the centre of the hood a narrow tube is fixed vertically; the top of this tube is curved laterally and furnished with a funnel, and after descending a considerable distance into the chimney, it ends in a slightly upward curve. The outer moving portion first mentioned contains numerous lateral openings, protected by wedge-shaped hoods, which prevent ingress of air; there are also four other openings at the top, constructed so as to facilitate egress of air. At the back of the funnel a square piece of metal sheet is attached, to act as a sail. It is scarcely necessary to point out how this apparatus works; the current of fresh air enters the funnel, is obliged to traverse the narrow tube, and creates a current by which smoke and vitiated air are driven out through the openings in the hood. The central narrow tube serves, besides the purposes already described, to balance the hood. According to size, the price of the apparatus is forty, fifty, or sixty francs; the address of the inventor is Rue de Lille, 31, Boulogne-sur-Mer. We understand that the invention is well spoken of by the highest authorities, and is in use in many of the hospitals, bathing establishments, &c., in Paris, Boulogne, and other places.

ON THE RELATION OF HYDROGEN TO PALLADIUM.*

By THOMAS GRAHAM, F.R.S., Master of the Mint.

It has often been maintained on chemical grounds that hydrogen gas is the vapour of a highly volatile metal. The idea forces itself upon the mind that palladium with its occluded hydrogen is simply an alloy of this volatile metal in which the volatility of the one element is restrained by its union with the other, and which owes its metallic aspect equally to both constituents. How far such a view is borne out by the properties of the compound substance in question will appear by the following examination of the properties of what, assuming its metallic character, would fairly be named hydrogenium.

Density.—The density of palladium when charged with 800 or 900 times its volume of hydrogen gas is perceptibly lowered, but the change cannot be measured accurately by the ordinary method of immersion in water, owing to a continuous evolution of minute hydrogen bubbles which appears to be determined by contact with the liquid. However, the linear dimensions of the charged palladium are altered so considerably that the difference admits of easy measurement, and furnishes the required density by calculation. Palladium in the form of wire is readily charged with hydrogen by evolving that gas upon the surface of the metal in a galvanometer containing dilute sulphuric acid, as usual.† The length of the wire before and after a charge is found by stretching it on both occasions by the same moderate weight, such as will not produce permanent distention, over the surface of a flat graduated measure. The measure was graduated to hundredths of an inch, and by means of a vernier, the divisions could be read to thousandths. The distance between two fine cross lines marked upon the surface of the wire near each of its extremities was observed.

Expt. 1.—The wire had been drawn from welded palladium, and was hard and elastic. The diameter of the wire was 0.462 millimetre; its specific gravity was 12.38, as determined with care. The wire was twisted into a loop at each end, and the mark made near each loop. The loops were varnished so as to limit absorption of gas by the wire to the measured length between the two marks. To straighten the wire, one loop was fixed, and the other connected with a string passing over a pulley and loaded with 1.5 kilogramme, a weight sufficient to straighten the wire without occasioning any undue strain. The wire was charged with hydrogen by making it the negative electrode of a small Bunsen's battery consisting of two cells, each of half a litre in capacity. The positive electrode was a thick platinum wire placed side by side with the palladium wire, and extending the whole length of the latter, within a tall jar filled with dilute sulphuric acid. The palladium wire had, in consequence, hydrogen carried to its surface for a period of one and a half hour. A longer exposure was found not to add sensibly to the charge of hydrogen acquired by the wire. The wire was again measured and the increase in length noted. Finally, the wire being dried with a cloth, was divided at the marks, and the charged portion heated in a long narrow glass tube kept vacuum by a Sprengel aspirator. The whole occluded hydrogen was thus collected and measured; its volume is reduced by calculation to Bar. 760 m.m., and Therm. 0° C.

The original length of the palladium wire exposed was 609.144 m.m. (23.982 inches), and its weight 1.6832 gm. The wire received a charge of hydrogen amounting to 936 times its volume, measuring 128 c.c., and therefore weighing 0.01147 gm. When the gas was ultimately expelled, the loss as ascertained by direct weighing was 0.01164 gm. The charged wire measured 618.923 m.m., showing an increase in length of 9.779 m.m. (0.385 inch). The increase in linear dimensions is from 100 to 101.605; and

* Read before the Royal Society, January 14th, 1869.

† *Proceedings of the Royal Society*, p. 422, 1868.

in cubic capacity, assuming the expansion to be equal in all directions, from 100 to 104.908. Supposing the two metals united without any change of volume, the alloy may therefore be said to be composed of—

By volume.			
Palladium	.. ..	100	or 95.32
Hydrogenium	.. ..	4.908	or 4.68

104.908 100

The expansion which the palladium undergoes appears enormous if viewed as a change of bulk in the metal only, due to any conceivable physical force, amounting as it does to sixteen times the dilatation of palladium when heated from 0° to 100° C. The density of the charged wire is reduced by calculation from 12.3 to 11.79. Again, as 100 is to 4.91, so the volume of the palladium, 0.1358 c.c. is to the volume of the hydrogenium 0.006714 c.c. Finally, dividing the weight of the hydrogenium, 0.01147 grm. by its volume in the alloy, 0.006714 c.c. we find

Density of hydrogenium 1.708

The density of hydrogenium, then, appears to approach that of magnesium, 1.743, by this first experiment.

Further, the expulsion of hydrogen from the wire, however caused, is attended with an extraordinary contraction of the latter. On expelling the hydrogen by a moderate heat, the wire not only receded to its original length, but fell as much below that zero as it had previously risen above it. The palladium wire first measuring 609.144 m.m., and which increased 9.77 m.m., was ultimately reduced to 599.444 m.m., and contracted 9.7 m.m. The wire is permanently shortened. The density of the palladium did not increase, but fell slightly at the same time, namely from 12.38 to 12.12; proving that this contraction of the wire is in length only. The result is the converse of extension by wire-drawing. The retraction of the wire is possibly due to an effect of wire-drawing in leaving the particles of metal in a state of unequal tension, a tension which is excessive in the direction of the length of the wire. The metallic particles would seem to become mobile, and to right themselves in proportion as the hydrogen escapes; and the wire contracts in length, expanding, as appears by its final density, in other directions at the same time.

A wire so charged with hydrogen, if rubbed with the powder of magnesia (to make the flame luminous), burns like a waxed thread when ignited in the flame of a lamp.

Expt. 2.—Another portion of the same palladium wire was charged with hydrogen in a similar manner. The results observed were as follows:—

Length of palladium wire	488.976 m.m.
The same with 867.15 volumes of occluded gas	495.656 ..
Linear elongation	6.68 ..
Linear elongation on 100	1.3663 ..
Cubic expansion on 100	4.154 ..
Weight of palladium wire	1.0667 grm.
Volume of palladium wire	0.08072 c.c.
Volume of occluded hydrogen gas ..	75.2 ..
Weight of same	0.00684 grm.
Volume of hydrogenium	0.003601 c.c.

From these results is calculated—

Density of hydrogenium 1.898.

Expt. 3.—The palladium wire was new, and on this occasion was well annealed before being charged with hydrogen. The wire was exposed at the negative for two hours, when it had ceased to elongate.

Length of palladium wire	556.185 m.m.
Same with 888.303 volumes hydrogen	563.632 ..
Linear elongation	7.467 ..
Linear elongation on 100	1.324 ..
Cubic expansion on 100	4.025 ..
Weight of palladium wire	1.1675 grm.
Volume of palladium wire	0.0949 c.c.
Volume of occluded hydrogen gas ..	84.3 ..
Weight of same	0.007553 grm.
Volume of hydrogenium	0.003820 c.c.

These results give by calculation—

Density of hydrogenium 1.977

It was necessary to assume in this discussion that the two metals do not contract nor expand, but remain of their proper volume on uniting. Dr. Matthiessen has shown that in the formation of alloys generally the metals retain approximately their original densities.*

In the first experiment already described, probably the maximum absorption of gas by wire, amounting to 935.67 volumes, is attained. The palladium may be charged with any smaller proportion of hydrogen by shortening the time of exposure to the gas (329 volumes of hydrogen were taken up in twenty minutes), and an opportunity be gained of observing if the density of the hydrogenium remains constant, or if it varies with the proportion in which hydrogen enters the alloy. In the following statement, which includes the three experiments already reported, the essential points only are produced:—

TABLE.

Volumes of Hydrogen occluded.	Linear expansion in millimetres.		Density of Hydrogenium.
	From	To	
329	496.189	498.552	2.055
462	493.040	496.520	1.930
487	370.358	373.126	1.927
745	305.538	511.303	1.917
867	488.976	495.656	1.898
888	556.185	563.652	1.977
936	609.144	618.923	1.708

If the first and last experiments only are compared it would appear that the hydrogenium becomes sensibly denser when the proportion of it is small, ranging from 1.708 to 2.055. But the last experiment of the table is perhaps exceptional, and all the others indicate considerable uniformity of density. The mean density of hydrogenium, according to the whole experiments, excluding that last referred to, is 1.951, or nearly 2. This uniformity is in favour of the method followed for estimating the density of hydrogenium.

On charging and discharging portions of the same palladium wire repeatedly, the curious retraction was found to continue, and seemed to be interminable. The following expansions, caused by variable charges of hydrogen, were followed on expelling the hydrogen by the retractions mentioned:—

	Elongation.	Retraction.
1st experiment	9.77 m.m.	9.70 m.m.
2nd	5.765 ..	6.20 ..
3rd	2.36 ..	3.14 ..
4th	3.482 ..	4.95 ..
		23.99

The palladium wire, which originally measured 609.144 m.m., has suffered by four successive discharges of hydrogen from it, a permanent contraction of 23.99 m.m.; that is, a reduction of 5.9 per cent in its original length. The contractions will be observed to exceed in amount the preceding elongations produced by the hydrogen, particularly when the charge of the latter is less considerable. With another portion of wire the contraction was carried to 15 per cent of its length by the effect of repeated discharges. The specific gravity of the contracted wire was 12.12, no general condensation of the metal having taken place. The wire shrinks in length only.

In the preceding experiments the hydrogen was expelled by exposing the palladium placed within a glass tube to a moderate heat short of redness, and exhausting by means of a Sprengel tube; but the gas was also withdrawn in another way—viz., by making the wire the positive electrode, and thereby evolving oxygen upon its surface. In such circumstances, a slight film of oxide of palladium is formed on the wire, but it appears not to interfere with the extraction and oxidation of the hydrogen. The wire measured—

* Philosophical Transactions, 1860, p. 177.

		Difference.
Before charge	443.25 m.m.	
With hydrogen	449.90 ,,	+ 6.65 m.m.
After discharge	437.31 ,,	- 5.94 ,,

The retraction of the wire, therefore, does not require the concurrence of a high temperature. This experiment further proved that a large charge of hydrogen may be removed in a complete manner by exposure to the positive pole—for four hours in this case; for the wire in its ultimate state gave no hydrogen on being heated *in vacuo*.

That particular wire, which had been repeatedly charged with hydrogen, was once more exposed to a maximum charge, for the purpose of ascertaining whether or not its elongation under hydrogen might now be facilitated and become greater, in consequence of the previous large retraction. No such extra elongation, however, was observed on charging the retracted wire more than once; and the expansion continued to be in the usual proportion to the hydrogen absorbed. The final density of the wire was 12.18.

The wire retracted by heat is found to be altered in another way, which appears to indicate a molecular change. When the gas has been expelled by heat, the metal gradually loses much of its power to take up hydrogen. The last wire, after it had already been operated upon six times, was again charged with hydrogen for two hours, and was found to occlude only 320 volumes of gas, and in a repetition of the experiment, 330.5 volumes. The absorbent power of the palladium had therefore been reduced to about one-third of its maximum.

The condition of the retracted wire appeared, however, to be improved by raising its temperature to full redness by sending through it an electrical current from a battery. The absorption rose thereafter to 425 volumes of hydrogen, and in a second experiment to 422.5 volumes.

The wire becomes fissured longitudinally, acquires a thready structure, and is much disintegrated on repeatedly losing hydrogen; particularly when the hydrogen has been extracted by electrolysis in an acid fluid. The palladium in the last case is dissolved by the acid to some extent. The metal appeared, however, to recover its full power to absorb hydrogen, now condensing upwards of 900 volumes of gas.

The effect upon its length of simply annealing the palladium wire by exposure in a porcelain tube to a full red heat, was observed. The wire measured 556.075 m.m. before, and 555.875 m.m. after heating; or a minute retraction of 0.2 m.m. was indicated. In a second annealing experiment, with an equal length of new wire, no sensible change whatever of length could be discovered. There is no reason, then, to ascribe the retraction after hydrogen, in any degree, to the heat applied when the gas is expelled. Palladium wire is very slightly affected in physical properties by such annealing, retaining much of its first hardness and elasticity.

2. *Tenacity*.—A new palladium wire, similar to the last, of which 100 m.m. weighed 0.1987 grammes, was broken, in experiments made on two different portions of it, by a load of 10 and of 10.17 kilogrammes. Two other portions of the same wire, fully charged with hydrogen, were broken by 8.18, and by 8.27 kilogrammes. Hence we have—

Tenacity of palladium wire	100
Tenacity of palladium and hydrogen	81.29

The tenacity of the palladium is reduced by the addition of hydrogen, but not to any great extent. It is a question whether the degree of tenacity that still remains is reconcilable with any other view than that the second element present possesses of itself a degree of tenacity such as is only found in metals.

3. *Electrical Conductivity*.—Mr. Becker, who is familiar with the practice of testing the capacity of wires for conducting electricity, submitted a palladium wire, before and after charging with hydrogen, to trial, in comparison

with a wire of German silver of equal diameter and length, at 10.5°. The conducting-power of the several wires was found as follows, being referred to pure copper as 100:—

Pure copper	100
Palladium	8.10
Alloy of 80 copper + 20 nickel	6.63
Palladium + hydrogen	5.99

A reduced conducting power is generally observed in alloys, and the charged palladium wire falls 25 per cent. But the conducting power remains still considerable, and the result may be construed to favour the metallic character of the second constituent of the wire. Dr. Matthiessen confirms these results.

4. *Magnetism*.—It is given by Faraday as the result of all his experiments that palladium is “feebly but truly magnetic;” and this element he placed at the head of what are now called the paramagnetic metals. But the feeble magnetism of palladium did not extend to its salts. In repeating such experiments, a horseshoe electro-magnet of soft iron, about 15 centimetres (6 inches) in height, was made use of. It was capable of supporting 60 kilogs., when excited by four large Bunsen’s cells. This is an induced magnet of very moderate power. The instrument was placed with its poles directed upwards; and each of these was provided with a small square block of soft iron terminating laterally in a point, like a small anvil. The palladium under examination was suspended between these points in a stirrup of paper attached to three fibres of cocoon silk, 3 decimetres in length, and the whole was covered by a bell glass. A filament of glass was attached to the paper, and moved as an index on a circle of paper on the glass shade divided into degrees. The metal, which was an oblong fragment of electro-deposited palladium, about 8 m.m. in length and 3 m.m. in width, being at rest in an equatorial position—that is, with its ends averted from the poles of the electro-magnet—the magnet was then charged by connecting it with the electrical battery. The palladium was deflected slightly from the equatorial line by 10° only; the magnetism acting against the torsion of the silk suspending thread. The same palladium charged with 604.6 volumes of hydrogen was deflected by the electro-magnet through 48°, when it set itself at rest. The gas being afterwards extracted, and the palladium again placed equatorially between the poles, it was not deflected in the least perceptible degree. The addition of hydrogen adds manifestly, therefore, to the small natural magnetism of the palladium. To have some terms of comparison, the same little mass of electro-deposited palladium was steeped in a solution of nickel of sp. gr. 1.082, which is known to be magnetic. The deflection under the magnet was now 35°, or less than with hydrogen. The same palladium being afterwards washed and impregnated with a solution of protosulphate of iron of sp. gr. 1.048, of which the metallic mass held 2.3 per cent of its weight, the palladium gave a deflection of 50°, or nearly the same as with hydrogen. With a stronger solution of the same salt, of sp. gr. 1.17, the deflection was 90°, and the palladium pointed axially.

Palladium in the form of wire or foil gave no deflection when placed in the same apparatus, of which the moderate sensitiveness was rather an advantage in present circumstances; but when afterwards charged with hydrogen, the palladium uniformly gave a sensible deflection of about 20°. A previous washing of the wire or foil with hydrochloric acid, to remove any possible traces of iron, did not modify this result. Palladium reduced from the cyanide and also precipitated by hypophosphorous acid, when placed in a small glass tube, was found to be not sensibly magnetic by our test; but it always acquired a sensible magnetism when charged with hydrogen.

It appears to follow that hydrogenium is magnetic, a property which is confined to metals and their compounds. This magnetism is not perceptible in hydrogen gas, which was placed both by Faraday and by M. E. Becquerel at

the bottom of the list of diamagnetic substances. This gas is allowed to be upon the turning-point between the paramagnetic and diamagnetic classes. But magnetism is so liable to extinction under the influence of heat that the magnetism of a metal may very possibly disappear entirely when it is fused or vaporized, as appears with hydrogen in the form of gas. As palladium stands high in the series of the paramagnetic metals, hydrogenium must be allowed to rise out of that class, and to take place in the strictly magnetic group, with iron, nickel, cobalt, chromium, and manganese.

Palladium with Hydrogen at a High Temperature—The ready permeability of heated palladium by hydrogen gas would imply the retention of the latter element by the metal even at a bright red heat. The hydrogenium must, in fact, travel through the palladium by cementation, a molecular process which requires time. The first attempts to arrest hydrogen in its passage through the red-hot metal were made by transmitting hydrogen gas through a metal tube of palladium with a vacuum outside, rapidly followed by a stream of carbonic acid, in which the metal was allowed to cool. When the metal was afterwards examined in the usual way, no hydrogen could be found in it. The short period of exposure to the carbonic acid seems to have been sufficient to dissipate the gas. But on heating palladium foil red-hot in a flame of hydrogen gas, and suddenly cooling the metal in water, a small portion of hydrogen was found locked up in the metal. A volume of metal amounting to 0.062 c.c. gave 0.080 c.c. of hydrogen; or, the gas, measured cold, was 1.306 times the bulk of the metal. This measure of gas would amount to three or four times the volume of the metal at a red heat. Platinum treated in the same way appeared also to yield hydrogen, although the quantity was too small to be much relied upon, amounting only to 0.06 volume of the metal. The permeation of these metals by hydrogen appears, therefore, to depend on absorption, and not to require the assumption of anything like porosity in their structure.

The highest velocity of permeation observed was in the experiment where four litres of hydrogen (3992 c.c.), per minute passed through a plate of palladium 1 m.m. in thickness, and calculated for a square metre in surface, at a bright red heat a little short of the melting point of gold. This is a travelling movement of hydrogen through the substance of the metal with the velocity of 4 m.m. per minute.

The chemical properties of hydrogenium also distinguish it from ordinary hydrogen. The palladium alloy precipitates mercury and calomel from a solution of the chloride of mercury without any disengagement of hydrogen; that is, hydrogenium decomposes chloride of mercury, while hydrogen does not. This explains why M. Stanislas Meunier failed in discovering the occluded hydrogen of meteoric iron, by dissolving the latter in a solution of chloride of mercury; for the hydrogen would be consumed, like the iron itself, in precipitating mercury. Hydrogen (associated with palladium) unites with chlorine and iodine in the dark, reduces a persalt of iron to the state of proto-salt, converts red prussiate of potash into yellow prussiate, and has considerable deoxidising powers. It appears to be the active form of hydrogen, as ozone is of oxygen.

The general conclusions which appear to flow from this inquiry are—that in palladium fully charged with hydrogen, as in the portion of palladium wire now submitted to the Royal Society, there exists a compound of palladium and hydrogen in a proportion which may approach to equal equivalents;* that both substances are solid, metallic, and of a white aspect; that the alloy contains about 20 volumes of palladium united with one volume of hydrogenium; and that the density of the latter is about 2, a little higher than magnesium, to which hydrogenium may be supposed to bear some analogy; that hydrogenium has a certain amount of tenacity, and possesses the electrical conductivity of a metal; and, finally, that hydrogenium takes

its place among magnetic metals. The latter fact may have its bearing upon the appearance of hydrogenium in meteoric iron, in association with certain other magnetic elements.

I cannot close this paper without taking the opportunity to return my best thanks to Mr. W. C. Roberts for his valuable co-operation throughout the investigation.

ON THE
SULPHATES OF OXIDE OF ANTIMONY.

By W. P. DEXTER.

THE various degrees of saturation of acids with the basic oxides have been considered, either in general as different classes of salts, or have been studied in detail, as combinations of the individual bases. The recent Memoir of Hr. Schultz, of Berlin,* has added largely to the number of compounds known as acid salts. In a work now nearly finished, I hope to show that, of the alum-forming bases, the sulphates of alumina and sesquioxide of chrome are capable of combining with an equivalent of hydrated sulphuric acid; that these acid-sulphates stand in close connection with the so-called double salts of the neutral sulphates of these bases; and that they may be regarded as compound acids, of which the double sulphates are the derivative salts. With the view of extending this inquiry to the salts of an oxide of similar composition, but of a different class, the following examination of the combinations of sulphuric acid with oxide of antimony was undertaken. No compound was here found analogous to the acid-sulphates of the alum bases, as no salt of oxide of antimony is known which has the composition of the alums. These compounds have been previously investigated by Brandès, and more recently, and with somewhat different result, by M. Pèligot. My own conclusions agree, as will be seen, with those of the German chemist; but are given, with hesitation, from experience of the difficulties with which the preparation of these bodies is attended.

For the purpose of demonstrating their existence, and examining their form under the microscope, the salts are easily made by boiling oxide of antimony or Algaroth powder with dilute sulphuric acid, until the water of the acid is expelled. The bisulphate remains as a white sandy powder, while the concentrated acid deposits on cooling acicular crystals of the tersulphate or neutral salt. By the action of hot water, these are converted into minute crystals of the disulphate. If the concentration of the acid has not been carried so far, intermixed with, or in place of, the bisulphate will be found crystals of an intermediate salt, of different form; and the liquid, if allowed to attract moisture from the air, deposits still other crystalline compounds, one of which contains equal equivalents of acid and base.

These are the salts which I have succeeded in obtaining in a sufficiently pure state for analysis. They are all crystalline, dissolve readily in hydrochloric acid, and with the exception of the disulphate, are decomposed by the action of water. To free them from the adhering acid liquid, they were left for a considerable time upon a porous earthen plate, protected from moisture by a glass containing a vessel of concentrated sulphuric acid. For the plates nothing was here to be found better than the red earthen saucers upon which flower-pots are placed. I had also flat discs made of the same ware, between which the salts, when partially dried, were forcibly pressed by means of a steel screw. The plates, before use, were heated, first in an oven, and then over a large gas flame, or an anthracite fire, and left to cool in a close vessel, over sulphuric acid.

For analysis the salts were dissolved in hydrochloric

acid, tartaric added so that the solution could be largely diluted without precipitation, and the antimony thrown down by sulphydric acid: the sulphuric acid was then determined in the filtrate as sulphate of baryta. If, on the contrary, the sulphuric acid be precipitated before the separation of the antimony, a sulphate of baryta is obtained, which after ignition is coloured, and retains traces of the metal that cannot be wholly removed by digestion with dilute hydrochloric acid. All the tartaric acid of commerce which I have examined, contains sulphuric acid; digestion of the solution in alcohol with a little carbonate of baryta removes the acid, but the tartrate of baryta is not quite insoluble in the alcoholic liquid. With carbonate of lime no better result was obtained. Through the kindness of Mr. Melvin, druggist of Boston, I received a supply of tartaric acid, in large crystals, which were quite free from sulphuric acid and all metallic impurity.

The precipitated sulphide of antimony was collected on a weighed filter, and dried at the temperature of boiling water; from its weight the quantity of the metal or oxide was calculated. As the antimony was in the state of oxide, and no nitric acid, oxide of iron, or other substance capable of decomposing the sulphydric acid, was present, an excess of sulphur in the precipitate was not to be feared. It has been asserted that the tersulphide of antimony retains at 100° C. a quantity of water, not amounting to 1 per cent, and requiring for its expulsion a temperature above 200°, by which the sulphide is converted into the black crystalline modification. To determine the precise amount of the error from this source, as well as from the possible presence of uncombined sulphur, the sulphide, after remaining many hours in the water bath, and until its weight varied, at most, one or two-tenths of a milligramme, was heated in a covered crucible, in an air bath, to 212°—220° for half or three-quarters of an hour at a time, with the following result:—

0.8192 SbS ₃	lost	2.1	0.4	0.5	
0.5445 "	"	1.0	0.3		milligrammes,

no constant weight being obtained.

The sulphide was then exposed to the same temperature, in a bulb blown upon a narrow glass tube, while the air was displaced by a slow stream of carbonic acid.

0.8536	lost	0.2	
0.5199	"	0.5	
0.6488	"	0.4	
0.3920	"	0.25	miligrammes,

these being all products of different analyses; the sulphide was completely converted into the black modification, and the weight on repeated trial remained unchanged. The error, whatever may be its source, of at most the tenth of 1 per cent, becomes insignificant when compared with the tenfold greater errors inevitable in the preparation of the salts.

Tersulphate, or Neutral Salt.—Oxide of antimony and Algaroth powder are dissolved in considerable quantity by hot concentrated sulphuric acid, the latter with disengagement of hydrochloric acid, the solvent power of the acid seeming to increase with its temperature. On cooling, a salt is deposited in slender needles, in such quantity, when the acid is saturated at its boiling point, that the whole becomes a thick semi-fluid magma. The crystals are long, four-sided prisms, with terminal faces, set often upon two opposite sides, alike at both ends of the prism. They seem to belong to the oblique rhombic system. The concentrated acid in which they have formed retains so little of the oxide in solution at the ordinary temperature that it remains clear when diluted with water, but by sulphydric acid a slight precipitate is produced. In the acid, diluted with about half its volume of water, the oxide in the cold is much more soluble.

In the preparation of the salt, the oxychloride was used in preference to the oxide, as the latter is not easily obtained free from alkali, and the acid was heated until all water was expelled, and vapour of hydrated acid abundantly given off. The semi-fluid mass of crystals

was brought upon a funnel, the neck of which was imperfectly closed by a glass rod, and they were then further freed from the acid upon the porous plates, as has been described. These operations were performed as rapidly as possible, in frosty winter weather, and in a room which was not heated, and was entered for no other purpose. When dry, the salt formed a mass of fibrous texture, very much resembling asbestos.

My analysis shows this to be the tersulphate, or neutral salt:—

1. 0.5933 of the salt gave 0.3648 SbS₃.
2. 0.6792 of the same preparation gave 0.4173 SbS₃, and 0.918 BaOSO₃.
3. 0.6413 of another preparation gave 0.3999 SbS₃, and 0.0859 BaOSO₃.

	Calculated.	I.	II.	III.
SbO ₃	54.94	52.82	52.78	53.58
3SO ₃	45.06	—	46.41	46.00
	100.00		99.19	99.58

The difference in the numbers found in the analyses from those given by calculation is to be ascribed to impurity of the preparations rather than to analytical errors. It is obviously difficult, by pressure between rigid plates, to remove completely all adherent liquid, and an excess of acid was therefore generally found in the salts thus prepared. That this was in the present case the cause of the discrepancy will appear when it is considered that the acid which adhered to the salt was hydrated acid, and that its water would be represented in the analysis by a loss. The loss, then, should correspond in amount to the excess of acid obtained; or, reckoned in equivalents as water, should be equal to the equivalents of the acid in excess.

The composition of the salt from the above analyses, taken in equivalents, is—

	II.	III.
SbO ₃	1.00	1.00
SO ₃	3.22	3.14
HO (loss)	0.25	0.13

The earlier analyses gave—

	Brandes.	Péligot.*
SbO ₃	56.4	50.2
SO ₃	43.2	51.9
	99.6	102.1
		97.4

Mr. Péligot considers the salt to contain four atoms of acid, a composition which requires 47.77 SbO₃ to 52.23 SO₃, if the equivalent of antimony be taken, as has been here done, at 122.34.† The question is one of considerable importance; for from the composition which he has assigned to this sulphate, and to the other antimonial compounds described in his Memoir, M. Péligot infers that the salts of antimony, like those of uranium, depart from the recognised law, according to which oxides containing three equivalents of oxygen require the same number of atoms of acid to form a neutral salt. The existence of such a sulphate of oxide of antimony is denied by him. "En effet il ne m'a pas été possible de rencontrer un seul sel contenant 3 équivalents d'acide combiné avec 1 équivalent d'oxyde d'antimoine; de sorte que pour les sels d'antimoine, de même que pour les sels jaunes d'urane, toutes les formules calculées dans les tables d'équivalents de M. Berzelius représentent des sels qui n'existent pas."‡

But the neutral salt may be prepared in another way, with a composition agreeing so nearly with that required by theory as to leave no doubt of its existence. By careful heating in a crucible of the oxide or oxychloride of antimony, with sulphuric acid, until the excess of acid

* The requisite data for calculation are given only for the first of the analyses of M. Péligot. If there be not a misprint, there is an error in this calculation, as occurs also in three out of the four analyses of the sulphates of antimony, of which the details are given. If from 1.66 of the salt, 2.22 BaOSO₃ were obtained, as stated in the memoir, there were 45.9 per cent of acid, instead of 51.9.

† Pogg., Ann., c., 563; Proceedings of the Am. Acad., Jan., 1862.

‡ Ann. Ch. Phys., 3d Ser., xx., 297.

is expelled, a white residue is obtained, the weight of which, however, is not quite constant, a minute quantity of acid being continually given off, probably on account of the moisture of the air. To obviate this source of uncertainty, the oxide or oxychloride was put into a bulb blown on the end of a narrow and thick glass tube, bent in the shape of a retort, close to the bulb. The neck was then drawn out so as to end in a point, in which, during the distillation, a drop of acid remained, and deprived of its moisture any air which might pass through it. A platinum crucible, lined with asbestos, served as a bath, and was covered with a sheet of mica, perforated for the passage of the neck, over which asbestos was also heaped. The heat was such as just to cause the acid to distil slowly over, the distillation from between one and two grammes of oxychloride lasting several hours: the temperature was above the melting point of lead. At the end, a minute drop collected in the point, at intervals of from a quarter to half an hour. By too long continuance of the heat the vapour of water-free acid is seen in the tube. The acid in the neck having been driven off, the point was sealed with the blowpipe. The product was a coherent, friable mass, crystalline on the surface to the naked eye.

Of a preparation made from the oxide, 0.4471 gave 0.2823 SbO_3 and 0.5953 BaOSO_3 ; of a salt made from Algaroth powder, 0.6177 gave 0.3946 SbS_3 and 0.815 BaOS_3 ; in the hundred,

	Calculated.	I.	II.
SbO_3	54.94	54.24	54.88
SO_3	45.06	45.72	45.31
	100.00	99.96	100.19

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, January 21, 1869.

Dr. WARREN DE LA RUE, F.R.S., President, in the chair.

THE minutes of the previous meeting were read and confirmed, the donations to the library were announced, and the following certificates read:—For the first time—Mr. E. D. Holditch, Mr. W. Rossiter, Mr. A. K. Howard; for the second time—Mr. E. L. Barret, Mr. J. J. Field, Mr. H. W. Kearns; for the third time—Mr. J. F. Allen, Mr. E. K. Muspratt, Mr. F. W. Hart, Mr. S. Williams. The Society then proceeded to ballot for the four last-named gentlemen, and they were declared duly elected.

The SECRETARY (Dr. Odling) announced that at the next meeting of the Society a lecture would be delivered by Dr. Wallace, "On the Chemistry of Sugar Refining;" Mr. Tomlinson had promised to give a lecture at one of the March meetings, "On Catharism, or the Influence of Chemically Clean Surfaces;" Professor Williamson had likewise promised a lecture; and the council hoped that Mr. Lothian Bell would do the same.

The first paper was then read by the Secretary (Mr. Vernon Harcourt); it was entitled—"On the Chemical Composition of Canaüba Wax," by Nevil Story Maskelyne, M.A. This wax is the product of a palm—the *Copernicia cerifera*—known to the Brazilians as the Canaüba tree. The glaucous coating which protects the younger leaves contains the wax in the proportion of about 50 grains to the leaf. It is collected and melted into a mass, and in this state constitutes a pale yellow or greenish body, somewhat harder and less resinous than the wax yielded by the noble palm of the Cordilleras. Its specific gravity is 0.99907, its melting point is 84°C ., and it yields 0.14 per cent of ash. The crude wax was

saponified by boiling with alcoholic solution of potash containing one-sixth of its weight of alkali, until the liquid became clear. The alcohol was then distilled off, and the residue thrown into a solution of neutral plumbic acetate, which produced a yellow colour. The liquid was evaporated to dryness, powdered, and extracted with ether, which removes the wax alcohols. By repeated crystallisations from ether, one of these alcohols, which appears to be melissin, was obtained in a state of purity. The insoluble lead-salt was afterwards decomposed by hydric chloride. In another experiment, the wax was saponified as before, the alcohol distilled off, and the acids set free by hydric chloride. The mass thus formed was dissolved in boiling alcohol, the acids saturated with ammonia, and then thrown down by baric chloride. The alcohol was now distilled off, the mass was thoroughly exhausted with water and alcohol, and the residue reserved for an examination of the acids. The alcoholic extract was digested with ether, and after repeated recrystallisations a body was obtained having the properties of, and corresponding in percentage composition to, melissin, $\text{C}_{31}\text{H}_{64}\text{O}$. To determine its constitution, it was converted, by heating to 270° with potash-lime into the corresponding acid. This acid, when very carefully purified, was highly electrical; it melted at 91° , and only dissolved in alcohol with the greatest difficulty. Its analysis agreed with the formula of melissic acid—viz., $\text{C}_{31}\text{H}_{62}\text{O}_2$ or $\text{C}_{30}\text{H}_{60}\text{O}_2$. Its silver salt contained 19.29 to 19.45 per cent of Ag; $\text{C}_{31}\text{H}_{61}\text{AgO}_2$ requires 18.85, and $\text{C}_{30}\text{H}_{59}\text{AgO}_2$ 19.32 per cent Ag.

It appeared probable, from the large amount of alcohols obtained, that they were present in the wax in the free state; 400 grammes of the wax was therefore boiled a great number of times with alcohol; this quantity yielded 126 grammes of soluble ingredients melting at 81° , and 274 grammes insoluble, melting at 86° . The soluble portion contained a resinous body, to which the yellow colour previously observed was due; this was removed by potash in minute quantity and plumbic acetate. A few crystallisations from alcohol and ether now yielded melissin in a state of purity.

The wax, therefore, contains no less than one-third of its mass of free wax alcohol, a fact of no little interest in vegetable physiology.

After the separation of the first crop of melissin crystals the remaining alcohols, both from the soluble and insoluble portions, were mixed and treated together. By recrystallisation, more melissin was obtained, and by repeated treatment with ether, benzol, and alcohol, several bodies were then separated; the following were analysed, and are described:—

1. An alcohol fusing at 105° , and having a composition represented by the approximate formula, $\text{C}_{39}\text{H}_{41}\text{O}_3$.
2. An alcohol fusing at 78° , and corresponding to formula $\text{C}_{46}\text{H}_{48}\text{O}_2$. It is probably cerotin.

These alcohols are all present in the wax in minute quantity as compared with that of melissin. The author did not succeed in preparing acids from any one of them.

Further attempts to identify the chief alcohol of the wax with melissin were also made. An iodide and chloride of the alcohol radical were prepared and analysed. The latter, however, did not give satisfactory analytical results, and was probably a mixture. Ammonia and aniline both act upon the alcohol, but the products obtained were not fully examined. Sulphuric acid gave an acid the potassium salt of which agrees in composition with the formula $\text{C}_{31}\text{H}_{63}\text{KSO}_4$.

A note attached to the paper mentions that the research was made in the years 1855-7, the author having since then been unable to complete it.

The PRESIDENT, in offering the thanks of the Society to the author, remarked that Sir Benjamin Brodie, who might be called the father of the study of wax, was present, and would perhaps favour the Society with some remarks.

Sir B. BRODIE, who observed that he had not come in time to hear the commencement of the paper, hoped that

its publication would induce some other chemists to apply themselves to the study of wax; he said chemists, because the necessary investigations were so tedious as to require the labour of two or three persons. He himself would be very happy to render any assistance he could to anyone who was willing to take up the subject. One of the chief obstacles to be encountered arose from the extreme difficulty of deciding from the percentage composition the true atomic constitution of the compounds. He regretted that Mr. Maskelyne had not applied some of the methods which he had found useful in fixing the constitution of these compounds. The action of chlorine, for instance, gave substitution compounds analogous to chloral which were very characteristic. In the same way, it would have been almost impossible to decide by analysis whether the paraffins belonged to the ethylene or marsh gas series, but the action of chlorine upon them was perfectly definite, and tended to fix them in the latter. Another most excellent method of study consisted in forming the ethers of the wax acids, and examining them.

In the study of wax, the composition of the bees'-wax produced in different countries would be found well worth investigation. He (Sir B. Brodie) had found that bees'-wax from Ceylon was quite different in composition from English; it contained no cerotic acid, whereas the English wax always contained that acid in the free state. The animal wax, called cerolein, too, with its peculiar tea-like fragrance, should be examined. Its composition appeared to approximate to that of butyric aldehyde, but it was very little known. Possibly some of the candle-makers could supply the crude material. It must be extracted by alcohol, and the cold solution evaporated.

"On the Connection between the Mechanical Qualities of Malleable Iron and Steel, and the Amount of Phosphorus they Contain," by Dr. B. H. Paul. It is generally considered that very small quantities of phosphorus in malleable iron and steel are most prejudicial to the quality of the metal. Quite recently, an eminent metallurgist has stated as a fact that much less than .3 per cent of phosphorus produces a decided and injurious effect on steel. The author has, however, been unable to discover any evidence sufficient to justify such a conclusion, and still less any reasonable explanation of it. He has recently had an opportunity of testing the truth of this conclusion, by determining the phosphorus in some samples of the iron and steel made by the new nitrate of soda process from British pig-iron known to contain phosphorus. Seven bars of iron and two bars of steel, made by the Heaton process, were examined; their tensile strength and extension had been determined by Mr. Kirkaldy. The iron bars had a tensile strength of from 46,547 to 52,842 lbs. per square inch of area, and an extension, when subjected to this strain, of from 21 to 28.6 per cent of their length. The two cast-steel bars had tensile strengths of 80,916 and 106,602 lbs., and extended to 3.3 and 13.7 per cent of their lengths. In the iron bars, the author found .144 to .38 per cent of phosphorus (average .237 per cent), and in the two steel bars .24 and .241 per cent. The author, therefore, thinks himself justified in asserting that the commonly-received opinion on this subject does not always represent the truth.

Professor MILLER had had opportunities of examining some of these steels. In fact, he might say that Dr. Paul's experiments had been suggested by himself. He had found in some careful analyses of his own, very unusual quantities of phosphorus, even in samples of high class iron—iron which worked well cold, and also at a red and bright yellow heat. It could hardly be doubted that in many statements of the composition of iron the amount of phosphorus found had been too low. The old method of estimating the phosphoric acid, which involved the throwing it down as iron-salt, was unreliable. The phospho-molybdate process, employed by Eggertz, was undoubtedly the best; but even this required the greatest care to avoid getting too low a proportion of phosphoric

acid. It was very difficult to ensure the entire precipitation of the phospho-molybdate. One thing was clear from these experiments, namely, that the presence of from 2 to 3 parts of phosphorus in 1,000 of iron was not so detrimental as was generally supposed.

The PRESIDENT inquired how the phosphorus existed in the iron, and the form in which it was eliminated during Heaton's process.

Professor MILLER could not speak with certainty of the condition of phosphorus in the iron; it probably existed as phosphide. It was, however, most certainly eliminated in the form of phosphate.

Dr. PRICE remarked that there was nothing new in the statement that such quantities of phosphorus might exist in wrought iron, but that with regard to steel he had yet to learn that .24 per cent of phosphorus could be present without injuring the metal. With regard to methods, he believed that the one at present in use was absolutely correct, that, namely, in which the phosphorus was separated as phosphate of iron and then determined with magnesia. The molybdate method was excessively tedious.

Mr. FORBES said that in Sweden they would not receive for making steel, iron that contained .1 per cent of phosphorus. Many works had had to stop for want of ores that were free from phosphorus. For one mine of such ore there were ten which yielded ore containing phosphorus, and they would most gladly use it if they could. He could not agree with Dr. Miller that the amount of phosphorus in iron was underestimated. The molybdate process was thoroughly understood in Sweden, and had been in use since 1856. Errors in the estimation of phosphorus could not be due to ignorance of that method.

Professor MILLER explained that he only meant to say that the molybdate process required care. No doubt the results obtained by Eggertz were perfectly correct. In answer to the President, Professor Miller then gave a short account of the Heaton process. A quantity of the nitre was placed in a wrought-iron pot lined with fire-clay; on this was put a perforated plate of iron, and 12 cwts. of melted cast-iron from a cupola furnace were then introduced, with sand and lime. During the reaction, fumes, first white, then brown, next grey, were evolved. A violent flame and a roaring noise attended upon it. When again tranquil, the metal was emptied on the floor of the furnace; the slag ran out and the pasty mass was pressed between rollers. He was unable to tell the proportion of phosphorus in the slag. The crude cast-iron employed contained 1.43 per cent, and the cast-steel obtained under .3 per cent. A part, at least, of the phosphorus lost was certainly to be found in the slag.

Dr. PAUL quite agreed with Mr. Forbes that Swedish steel was free from phosphorus. As far as he could learn, there was no other evidence in proof of the injurious action of phosphorus on steel.

NOTICES OF BOOKS.

The Scientific Review: a Monthly Record of the Progress of Science and its Application to the Arts and Manufactures (with which is incorporated the Journal of the Inventors' Institute). Conducted by R. MARSDEN LATHAM, Esq. Vol. iv., No. 1, January 1st, 1869.

FOR obvious reasons, one scientific journal seldom criticises a journal devoted to the same field of enquiry, nor shall we depart from this wholesome rule; but as this number has been forwarded to our office "with the editor's compliments," and as it contains some very original views and some trenchant strictures on world-renowned names, we feel constrained to allow the *Scientific Review* to vindicate its peculiar claims to a hearing, confining ourselves mainly to quotations, but taking the liberty of italicising a few noteworthy passages.

Of the Heaton process for manufacturing steel, the editor writes:—

"Any tyro in Chemistry can perceive how nitrate of soda acts in refining impure iron, whatever be the quality of the product obtained."

In noticing the proceedings of the French Academy of Sciences, the editor calls M. Jamin's differential refractor for polarised light—

"An ingenious optical instrument, by means of which the torturing of a beam of light is pushed to a most exquisite degree of perfection."

The following query will doubtless receive the attention of the Academy of Sciences:—

"M. Gaube—a name which is new to us—read a paper on the composition of that beautiful little plant—the pest of our gardens—*Achillea Millefolium*; pray why does the Academy omit to print this note?"

Referring to M. Janssen's recent spectrum observations, we read:—

"The day after the famous eclipse of the sun, M. Jansen imagined that by directing a spectroscope to the borders of the disc he might prove that the great protuberances were still visible (or rather their spectrum), and found that such was the case. . . . This simple observation, which might have suggested itself to a school-boy of ten years of age, has given rise to a considerable number of short notes addressed to the Academy, and would appear, from the interest attached to it, to be one of the most marvellous discoveries of the age!"

Professor Hofmann is next favoured with the editor's disparagement.—

"Professor Hofmann continues his researches on certain compounds isomeric with sulphocyanic ethers, and illustrates them, as usual, with a host of useless formulæ, which detract considerably from the interesting facts which he brings forward."

And thus is Professor Tyndall's latest discovery estimated:—

"The author encloses certain gaseous substances in a glass tube, and passes through the tube a beam of electric light. This gives rise to various optical phenomena; certain colours and forms are produced in which Professor Tyndall sees evidence of chemical decomposition. We must confess that we do NOT see it."

The longest article in the number, by Dr. Macvicar, is devoted to "The New Chemistry." The distinguished inventor of the tetrad will feel interested in hearing that the tetrad is the basis of the system, and that—

"The four etherical atmospheres or dynamospheres of the four constituent units of weight of the tetrad are conceived to be unified into a sphere, so that, while the nucleus is tetrahedral, the periphery [sic.] is spherical, and the form, therefore, embraces within its limits all possible symmetrical polyhedra."

Our younger readers who lately witnessed Dr. Odling's brilliant experiments with the oxyhydrogen flame, will be glad to have the following lucid explanation of a phenomenon which the lecturer was necessarily obliged to describe somewhat briefly; and with the following dithyrambic strain, inspired by H and O, we cannot more fitly conclude:—

"Our hydrogen and oxygen are so dissimilar in every morphological feature, that whenever they have a chance they must unite with great force; the atom of H plunging with great velocity into the centre of O in the line of its axis, and generating intense heat or palpitation of O. Hence it is only to be expected that when both exist in the free state without any trentagonal element present to be a mould for O, and to sustain its singular form from the latter in the instant of the genesis of HO will shake itself free of its peculiarity of form, and open so as to let the axes of the five bitetrads of which it consists fall parallel to that of the incident atom of H, which also acts as a linear force, and a wedge insisting on this transformation."

CORRESPONDENCE.

ARTIFICIAL FORMATION OF ATACAMITE.

To the Editor of the Chemical News.

Sir,—Permit me to refer, in a few words, to Mr. Field's interesting communication to the CHEMICAL NEWS on the subject of atacamite.

I was aware that atacamite had been formed artificially in several ways. But my experiments were made with the intention of trying the action of chloride of sodium upon all the common ores of copper occurring in Cornwall. And I wished to do this under perfectly definite conditions. The paper in the *Journal of the Chemical Society* gives the only one of my results which approached success. Other experiments, with malachite, redruthite, chalcopryrite, &c., have not yet been completed.

It will be recollected by the readers of my papers on cupric oxychlorides in the *Journal of the Chemical Society* (1864) that I therein showed that the Cornish atacamite, first described as an English species by me, had the same composition as the Chilian specimens analysed and described by Mr. Field.

I need scarcely add that the correction suggested by Mr. Field in the wording of a sentence in my paper gives the meaning intended to be conveyed by the paragraph in question.—I am, &c.,

A. H. CHURCH.

Royal Agricultural College, Cirencester.
Jan. 27, 1869.

THE COHESION FIGURES OF LIQUIDS: OLEOGRAPHS.

To the Editor of the Chemical News.

SIR,—I have received a number of applications for an opinion on Dr. Moffat's oleographs of the cohesion figures of liquids. Several persons who deal in, or use oils largely, are anxious to make use of the process, provided its results be reliable. Perhaps you will allow me to give my reply through the medium of your journal.

Dr. Moffat has been so good as to send me thirty-six impressions illustrative of his ingenious process. I am sorry not to be able to report favourably on them as types of cohesion figures. Their chief fault is the absence of distinctive character. These thirty-six oleographs are so much alike, that they might fairly pass for variations of one oil. They consist, more or less, of a large disc perforated with holes. This arises from allowing the oil to remain too long before an impression is taken. There is a moment in the existence of every film, when the characteristic figure is presented, by which it can be recognised and the purity tested. If this characteristic figure could be seized and fixed at the right moment, the process would be of value, for we should then not only have figures of great variety and beauty (those of no two liquids being alike), but such figures would serve as types for comparison: whether the oleographic process is capable of grasping this result, I cannot say; but I think an attempt ought to be made with that end in view. I have published a considerable number of figures in which the characteristics are presented. Some liquids, such as the oils of lavender, turpentine, coriander, &c., may have each two or more characteristic phases; these should, if possible, be given.

In the *Philosophical Magazine* for June, 1867 (Plate IV.), are represented the three characteristic phases of oil of coriander. Now no oleograph of this oil would satisfy me that did not represent these three figures. The third figure of this group would print as a perforated disc, as in Dr. Moffat's oleographs, but this itself would be of no value at all, for it would distinguish nothing unless associated with the other two phases which distinguish oil of coriander from all other liquids. Oils of the same family

present figures with broad features in common, but with essentially different details. No one, for example, would hesitate to distinguish between castor and croton oils; but if the figures were left one, two, or three minutes on the water or other surface, all character would be lost. Before any one attempts to fix these figures, he should educate his eye (and this may soon be done) by a careful study as to what one liquid does that is different from any other liquid, how long it takes in doing it, and whether the peculiarity in question can be fixed at the right moment.

Supposing the oleographic process to be made capable of fixing the characteristic forms of these figures, it can, I suppose, never be made to fix the colours which often greatly heighten their beauty.—I am, &c.,

C. TOMLINSON.

Highgate, N., Jan. 19, 1869.

MISCELLANEOUS.

Glasgow Philosophical Society (Chemical Section).—A meeting was held in the Society's rooms, Andersonian University, on Monday, the 18th inst., at eight o'clock in the evening, Dr. Anderson, president, in the chair. Six new members were admitted. A paper was read, by Messrs Bald and Maclear, "On the Salt Deposits of Strassfurt." We hope to be able to give this paper in detail in our next issue.

Testing the Strength of Acetic Acid.—In attempting to determine the strength of acetic acid by means of the hydrometer, it will be remarked that certain anomalies present themselves; thus, there is no difference in the specific gravities of acids containing respectively 53 and 100 per cent of true acetic hydrate, both having precisely the same density, 1063, at 60° Fahr. (water = 1000). The heaviest liquid acid is that containing 80 per cent, the specific gravity of which is a trifle over 1073; but from this point upwards to the acid of 90 per cent there is no appreciable difference in the gravity. Again, a sample weighing 1067 may either represent an acid of 60 per cent or may contain as much as 98 per cent of true acid. It is, therefore, customary to guarantee the highest degree of concentration by specifying the temperature at which the acid becomes solid, or, rather, the highest point at which the already glacial acid resists liquefaction. Another guide which may often prove serviceable in the identification of an acid which, although of a high degree of concentration, is not actually glacial, is the fact observed, we believe, independently by M. Berthelot and Mr. E. Chambers Nicholson, that such acid becomes inflammable when the temperature is raised to the boiling-point. If we take, for instance, about a drachm of the acid of 95 per cent and heat it in a test-tube to the boiling-point, it will be found that the vapour takes fire on applying a lighted match, and burns steadily as long as the ebullition is maintained; if, however, 10 per cent of water be mixed with the sample there will be great difficulty in causing inflammation, and the vapour when ignited will only burn with a lambent flame of pale blue separated cones, whilst below this strength the acid vapour is altogether unflammable. By this test, then (avoiding a too prolonged ebullition, which increases the strength of a weak acid), we have a ready means of estimating the quality of liquid samples of a high degree of concentration without resorting to the more tedious method of acidimetry. It has only to be stated, in conclusion, that the boiling-point of the ordinary qualities of acetic acid, although higher, is so little removed from that of water that the indications of the thermometer are not much more to be relied upon than those of the hydrometer. In many respects carbolic acid imitates the deportment of acetic acid in the characters above described; it likewise becomes glacial upon separation of the last traces of water.—*The Photographic Journal*.

NOTES AND QUERIES.

Separating Iron and Brass Dust.—Certain improved apparatus for separating filings or other small bits or particles of iron or steel from other metallic filings, scrapings, chippings, or other small particles or dust, by use of magnets. Patentee, William Thomas Bissell Allday; No. of Patent, 67; date, January 10th, 1860. Address, Rednall, Worcestershire.

Ice-House.—"Zero" may find a very good account of the mode of constructing an ice-house in Ure's "Dictionary of Arts, Manufactures, and Mines," published by Longmans, sixth edition, vol. ii., p. 643. The article is accompanied by a woodcut, and is too lengthy to be properly abstracted in "Notes and Queries"; the work alluded to is found in the Library of the Commissioners of Patents.—ALIQUIS.

MEETINGS FOR THE WEEK.

MONDAY, 1st.—Medical, 8.

— London Institution, 6.

— Royal Institution, 2. General Monthly Meeting.

TUESDAY, 2nd.—Royal Institution, 3. Mr. Westmacott, "On Fine Art."

WEDNESDAY, 3rd.—Society of Arts, 8.

— Pharmaceutical, 8.

THURSDAY, 4th.—Royal Institution, 3. Dr. Foster, "On Involuntary Movements of Animals."

— London Institution, 6

— Royal, 8.30.

— Chemical, 8. Dr. Wallace, "On the Chemistry of Sugar Refining."

— Royal Society Club, 6.

FRIDAY, 5th.—Royal Institution, 8. Mr. James Fergusson, "On Tree and Serpent Worship."

— Geologists' Association. Anniversary Meeting, 7.30.

SATURDAY, 6th.—Royal Institution, 3. Dr. Odling, F.R.S., "On Hydrogen and its Analogues."

TO CORRESPONDENTS.

* * VOL. XVIII. of THE CHEMICAL NEWS, containing a copious index, is now ready, price 11s., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes, are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xix. commenced on January 1st, and will be complete in twenty-six numbers. It will contain a verbatim report of Dr. Odling's Juvenile Lectures at the Royal Institution "On the Chemical Changes of Carbon," and original papers from some of our leading English and Foreign Chemists and Physicists.

The Royal Astronomical Society.—The following startling news appears in a contemporary:—"The announcement has recently been made to the Royal Astronomical Society of England of the discovery, by means of the spectroscopic, of a hitherto unknown envelope of gaseous matter surrounding that body, of a thickness of seven or eight thousand miles. Its precise composition has not yet been determined, but will probably before long be ascertained." It is to be hoped that immediate steps will be taken to rescue the Fellows of this learned body from their perilous position.

Professor Attfield's communication "On the Igniting Point of Petroleum" is unavoidably postponed until next week.

C. Hunter.—One cell of a battery will not efficiently decompose water; you will require two or three cells at least. If the zinc plates are properly amalgamated there will be no frothing in the cell.

J. W. C.—We cannot undertake the responsibility of saying whether any particular individual is a "respectable practitioner" or an "advertising quack." As a rule respectable practitioners do not advertise.

F. D.—We know of no book which treats on the formation, fitting-up and management of a laboratory. Much depends upon the kind of work to be done in it; whether research, or commercial analyses; how many assistants are employed, and if pupils are taken. Length of purse is also an important consideration. As you say expense will be no consideration, the best plan will be to see as many private and public laboratories as possible, select the most useful points from each, and then draw out a plan for yourself. You will find it advantageous to consult Greville Williams's "Handbook of Chemical Manipulation" before deciding about the final arrangements.

Communications have been received from Dr. R. Angus Smith, F.R.S.; G. F. Rodwell; H. Renshaw; E. Hart; J. W. Clements; R. Mallet, F.R.S.; C. Hunter; J. Samuelson; W. T. Suffolk; Professor R. Fittig; M. Aguilar; G. Henry; A. M. Scott (with enclosure); A. Wuth (with enclosure); H. McLeod; A. N. Palmer; J. C. Lee (with enclosure); Dr. Noad; R. N. Shaw; Mottershead and Co. (with enclosure); R. R. Tatlock; Dr. Odling, F.R.S.; T. Hill; J. Spiller; D. Saul; and Professor Church.

THE CHEMICAL NEWS.

VOL. XIX. No. 479.

SCIENCE AND VIOLENCE.

HISTORIANS tell us that there is a vein of thought running through even the empires of the battle-axe. We think the vein in many cases thin, and especially in ancient times when the elementary instinct of power governed more fully than in later days. The motives of men become more complicated as their affairs become more numerous, and nations contain as many reasons for action as they contain families. In old times men were not ashamed to confess their simple love of greatness and, in default of that quality, their love of admiration. They liked to be carried about like some Queen of the May, or with elephants to increase their apparent size, and numbers to atone for their actual littleness. We must not despise these promptings of nature—these undefined strivings after the beautiful and the good. According to an old northern saying of our people, “it came up the back to do so,” explaining an unknown impulse by a vague feeling that the whole column of the body was filled with a power that took its own direction.

When victory produces self-satisfaction and leisure, there is an attempt to think more clearly, and we have every nation giving out with more or less fulness its own theory of itself and its relations to the universe. They seek wisdom for a little and encourage learning, but always with the rod in hand, always letting you understand that above all stands power. Their rights are those of the New Zealanders—“I ate the former possessor.”

Still this love of wisdom has taken a very brilliant form at some courts, and in part the love has been sincere. The old laws of Manu enjoined it, and gave orders to the king to learn “from those who knew the three Vedas the triple doctrine comprised in them together with the primeval science of criminal justice and sound policy, the systems of logic and metaphysics and sublime theological truth; from the people he must learn the theory of agriculture, commerce, and other practical arts.” Here is seen the love of wisdom and goodness which has burnt in the East at various times and places more violently than we can now imagine, so that at some periods it seemed certain to take the lead in all governments. Kings and courts were dazzled by knowledge, and wise men were invited and honoured, whilst systems of abstract thought grew up in such variety that it is hard to find one in Europe which has not existed previously in the East. So familiar, indeed, had they become that many sunk down by a natural decay to less serious thinkers, and after various transformations, when their masters died, fell exhausted in some ignoble *reductio ad absurdum*. That this is true we may illustrate by the account of the ostler stealing his master's horse and caricaturing the idealists by saying that there was no horse, it was only an idea. The master returns the same answer after he gives him a flogging, saying that, in reality, he had received no flogging; exactly as Johnson and Boswell laughed at Berkeley instead of the far-distant Fartosh. It is melancholy to see great thoughts coming down in the world like decayed families, as a Greek emperor might have seen, had he looked forward, his descendants intended for a throne dying unknown and lonely on the extremity of our distant island. We tremble for our race when we think of the East and look on men who loved truth so devotedly dying apparently by millions, rubbed off the floor of life by the sweeping hand of the selfish love of power. These scenes were in struggles for magnificence, in which sunshine and glitter had the victory. That is a wonderful place where the sun

shines; and the greatest pun perhaps ever made was the saying “Light comes from the East,”—for after all it is a pun.

Passing over times and places, we find that to invite wise men to courts became such an admired taste that King Arthur, we are told, had two hundred philosophers at his court. Nothing shows the bent of men more than the statements of romance: there men do exactly as they please. We had certainly an inclination to run through the ages, and examine the relations of men of science and learning to power. It is a good habit, we think, the comparison of times; and we do not care to be laughed out of it by the story of the German writer on police, who began his history, whether real or mythical, in the words “Adam was the first policeman.” We have seen with our own eyes a claim made for this name as the first freemason, a no less wonderful piece of literature. We move more freed from present human prejudices in ancient times; as soon as we arrive at the breakage of the Roman empire, or perhaps rather at those ages where the busy roots of modern life grew in darkness, men became as cautious of speech as if they were at the back of their friends. In old times there began a simpler relationship between the men who had original thought and those who had power. But the two powers did not coalesce well, and one thinks with shame even now of Plato attracted, shuffled off, and re-attracted to one Dionysius after another only to be repelled at last. In earlier times one feels sorry for poor Cræsus seeking the sympathy of the wise, and one learns by such things that they knew their position as well as any can know it now, although they have been obliged to move to the side as the sword came in their way. Indeed, we feel that it must have been a great country that felt, even in the advanced social period, that Diogenes was a power. A small people would have despised him, and it would require the most choice of our time to treat such a one with attention such as he met.

In reality, however, we have not much to do with such men; they were not the intellectual ancestors of chemists, although, being somewhat related, since men who thought on matter and mind were more allied in old time than with us, we think it interesting to see how, as a race, they were treated by the men of action of the time. Whenever these desired to fight for their interests, they cleared the ground of all such impediments as learning produced, just as they would have removed beggars and strolling minstrels. Perhaps scientific men are rather the descendants of astrologers and magicians that graced the courts of the East, and who at times seemed to have real power and at other times were superior slaves. The time of action came, and they were scattered like mummers. The scientists may spring from the physicians of Egypt who advanced so far in their division of labour that it was considered that one part of the body was enough for the study of one man. They must have risen high when one who was sent to the Persian court was so incensed by the removal from his wife and family that he found means to cause an invasion of Egypt, according to a report. But although we may view them as we do, cultivating chemical knowledge with some success on the Nile, we see them also as unhappy instances of the fact that the man of mere action has had his way, and the nation has long suffered the deepest degradation.

Ever will the man of mere action put aside the best, that his little purpose may flourish. We have heard of an engineer who proposed in this, our own island, to drive a railway through a park which had been the property of the citizens longer than history could tell, so as to save a slight curve, such as he often made apparently for his amusement. We have heard of another who proposed to carry a similar road through an ancient church, in which the bodies of kings and queens had lain for centuries, and had fascination to delude others into the crime, and now the spot is made the stable of screeching and unfeeling locomotives. It is always the same with the man

of mere action; we have seen him in various conditions but he is always one. He has cheated us at marbles, where his principles were fully developed as a chicken's are from the shell; we have seen him grown into manhood, and he has bullied and browbeaten us, and we have seen him old, when he has wheedled and made use of us. His demands are for himself. We have known him wandering over Europe for inventions for which he obtains a patent, careless of the fact that another is the inventor, and when this has failed we have seen him trying to prove that no man has a right to keep his own discoveries to himself, hoping by this means that the sharpest eye and longest purse will seize and keep them. He has even obtained the apparent consent for the time of some most eminent men, having deceived the very elect of the nation. He wishes to seize the golden egg as soon as it is laid, but he cares little for the life of the hen. That egg will last his day. Everywhere he is the same; he will open the world with his sword; it is to him a mere oyster or food supply, and it matters nothing to him if he sacrifices the life of a saint or a fly. Shakespeare saw one undisguised on a heath near Forres when describing himself in these words, "and like a rat without a tail, I'll do, I'll do, I'll do." This expresses activity without thinking.

There is, however, the man of action in the higher sense inspired by thoughts and working them out. Him it is probable no man can equal; such have become the most admired of mankind, but as every one has his hero we shall make no allusion, as it is not of consequence to stir up opposition on a point little to be regarded here.

The man of mere action, whose principles are self, differs so much from the man of action governed by love of his race, that in narrowness one can only compare him with the bridge of Sarat which, if he ever cross, it will be because he surpasses it in narrowness. To us he seems better named the man of violence. He has never learnt principles, and to a man who cares not for these we need not speak of science; its volumes turn into receipt books.

It has been said that the government of this country does too little for scientific men. The work of science, like other departments of thought and action, has been left to be developed by the genius of the country. Looking at the history of scientific ideas, it seems to us that our nation has not much to fear in comparison with others; We shall even go farther, and say that for breadth of views no nation can go beyond us. We are even still more prejudiced, and are inclined to think that, taking the larger and wider theories into consideration, we have done more than our share. The national force has been great, and that instinct which has produced so many poets of the highest class has also produced bold thinkers leaping our fields of thought with seven-leagued boots, whilst the workers on the fields have been too few for full cultivation. We are not quite prepared to prove all this, but we have long thought it, and it is not a matter on which to produce rapid conviction to an opponent. But, from whatever cause, we consider ourselves lagging: our powers are not made the most of; we consider that in this country the number of purely scientific men is too small. We think, too, that the powers of the whole are not fully brought into action. There is also a want of care to produce a supply, and, when produced, to give them position. The country must suffer by this in every department where science is of value.

The first result of this belief, which is held by all men who think on the subject, is to blame the government. We, too, have had an inclination to do so, and there we must seek help; but as a question of morals, who is to blame? If we search the factories of this country, do we find that the manufacturers have been before the government, and that they have made such use of scientific men and scientific knowledge as to enable them to stand guiltless? Our belief is against this. We stand guilty as a nation of an attempt to ride over principles of

science and to obtain results by the violence of our activities.

There have been many wise men who have devoted great sums to the nation, that those after them might be taught without cost, but ever these witches from Shakespeare have come and have wrested the power from their hands, turning it to baser ends. The man of selfishness and mere action has been, as usual, at the money boxes; and he has done more: he has lived on the brains of whole cities and counties. He has darkened whole generations for whom his father had provided light; and it is not much to say that for every day's food a family has been ruined. Cannibals are more easily taught, and less likely to return to their feasts. In early times we have seen them in the governments; in modern times they are more difficult to find: they hunt after charities provided for the poor and ignorant, or take hold of other's shares that make them rich as princes.

We desire protection from these men of violence. We look on the keen minds of our ancestors, and say to ourselves "if such men as these had found peace and fair-play, what a world we should now have." We read the words of Roger Bacon, written 600 years ago, and most interesting to chemists:—"The elements are made out of *yle*, and every element is converted into the nature of another element, and everything into everything; for barley is a potential horse—that is, by its occult nature, and wheat is potentially man, and man is potentially wheat." When men begin to put the problems of nature so sharply before them, they enquire. Let us suppose *yle* to be the substance of the metaphysicians, and we have an opinion little differing from one lately put forward to account for elements, although disagreeing as to the transmutation—a point that most chemists will very willingly concede in theory. Well, this style of enquiry was suppressed by authority, and it is for others better acquainted with our old universities to say if up to this century a more advanced knowledge of matter was received by those who studied at Oxford. Six hundred years have been given for the study, and we think we have met many behind Bacon. He certainly thought Oxford a proper place for such studies. Let us imagine the world, if he had been encouraged to make a school; but one step may destroy a life, and that solemn truth stands before us every day. We seek protection from governments, although they in old time have destroyed so much that thoughtful men built; but the men of violence have changed their beat, they are not in authority, they find more to be gained by lurking in secret.

It is not for single individuals to protect themselves—they stand as nothing before their fellow men, on rare occasions excepted, when they become representative—it is not even possible for a community to protect itself—it lives, but its organisation does not continue permanent except in its government. It is only the immortal that can protect us through generations; and in the State we have the nearest approach to that continuance which savours of immortality. It is for this reason, then, that we must look to governments, not as men unable to help themselves, but as men who, having less than a century to live, implore for the young the aid of that whose life will remain to long futures.

There has been in England a pride of individual life which has brightened its annals in a manner peculiarly glistening, but has greatly prevented the concentration of its power in many directions. Its too practical eye has never seen the abstract living government moving on through all generations, muttering its thoughts through changeable men, and has failed too much to know that this could act as a lens whereby the people's power could be intensified. As men, we are not narrow, and there is an elasticity in our institutions which allows of great width; but from whatever cause, our universities have been lacking in breadth, and they have taught our statesmen. Out of the earth, deep among the roots, has grown the sap of new institutions, and the nation must

drive on the learned men who were appointed to lead it. It is a misfortune, and because of this it seems needful that universities shall no longer be few in number, so that all the country should be shaped in one groove, but sufficiently numerous to present oppositions to any body of men who will too exclusively pursue one idea. The existence of such will be a safeguard to the nation, who will be able to have a choice of education for their sons, whilst the control of government will prevent them sinking into those private depths of selfishness which have drowned so many endowments. If education is not under a great public control the funds will be again wrested from their proper ends. The government only can protect the land from "the violence of men that dwell therein."

ON THE SULPHATES OF OXIDE OF ANTIMONY.

By W. P. DEXTER.

(Concluded from page 57.)

Basic Salts.—The basic sulphates of antimony form a series of salts in which the oxide is combined with two, one, and half an equivalent of acid. Besides these, there appear to be others, only one of which I have examined, and which are probably combinations of these simpler salts. They occur under various and often unexpected conditions; but, in general, the degree of dilution of the acid seemed to have the greatest influence in their production. When oxide of antimony is boiled with sulphuric acid diluted with about its volume of water, a turbid liquid is obtained in which, under the microscope, no distinctly crystalline body can be perceived. On continuing the ebullition, when the acid has reached a certain degree of concentration, the liquid, provided more oxide be present than it can dissolve, becomes suddenly clear from the subsidence of a heavy sand-like body. If the boiling have been stopped as soon as this takes place, the substance will be found under the microscope to consist of flat rhombic prisms of considerable size. By continuing the boiling but for a few seconds these disappear, without any change of appearance perceptible to the eye; but by the microscope the prisms are seen to be replaced by octahedral crystals. Generally, however, the prisms are from the first mingled with the octahedral salt, from which it is very difficult in this way to obtain them quite free. By a slight concentration of the acid, as has been said, the octahedra are left perfectly free from the prisms.

These octahedra appear to belong to the regular system, are frequently more or less distorted, but very seldom show any replacement or modification of the crystalline form. The faces are striated, and to these little projecting angles, acting like prisms, is due, it seems to me, the slight amount of colour which they exhibit in polarised light. As the liquid in which they have formed cools, crystals resembling those of the neutral sulphate generally separate. To prevent admixture with these, the porous plate upon which they were collected was covered and imbedded in hot sand. In their analysis were obtained—

1. From 1.1663 salt, 0.863 SbS_3 and 1.1815 BaOSO_3 .
2. From 1.1359 of another preparation, 0.847 SbS_3 and 1.1724 BaOSO_3 .

	Calculated.	I.	II.
SbO_3	64.65	63.57	63.91
2SO_3	35.35	34.79	35.44
	100.00	98.36	99.35

The salt is the bisulphate, and its formula $\text{SbO}_3.2\text{SO}_3$

Mr. Péligot, by the action of fuming sulphuric acid upon oxide of antimony, obtained a salt "in the form of small, brilliant crystals," of which he has given the analyses:—

SbO_3	63.0	64.3
SO_3	37.1	35.0

and which therefore seem to have been the salt just described. In fact, hydrated sulphuric acid, gently warmed, unites with the oxide to form this compound, which is then dissolved at a higher temperature, with production of the neutral salt.

In the formation of both the octahedral and prismatic crystals, there appears to be direct conversion of the undissolved oxide into the salts: they are also deposited from a solution of the oxide in sulphuric acid of the proper concentration. There is, however, a peculiarity attending their formation. When they have separated from the acid liquid, they can be decomposed by addition of water, and again reproduced by concentrating the liquid. But if by still further evaporation they have been re-dissolved in the acid as neutral salt, or if the oxide be at first dissolved in concentrated acid, and the solution in either case decomposed by water, on evaporation the octahedral crystals will not be obtained, or will be obtained only in small quantity; the separated basic salt re-dissolves at last completely in the acid. By arresting the evaporation at the proper period, as has been said, octahedral crystals may be deposited from the liquid on cooling, but no conversion of the basic salt into them seems to take place. By decomposing the basic salt with carbonate of soda, and treating the resulting oxide with dilute acid, the octahedral crystals can be again produced.

Finding it difficult to obtain the salt mentioned as occurring in flat prisms free from the octahedral crystals by concentration of the acid liquid in an open vessel, experiments were made with acid of various degrees of dilution. An acid of sp. gr. greater than 1.6, gave by boiling with the oxide octahedral crystals: at 1.597 the prisms first appeared: at sp. gr. 1.57 the oxide was converted into prisms free from the other salt, but smaller than those produced by the gradual concentration of the liquid; and at 1.554 the product consisted only of needles. So that the production of the body in question is confined within narrow limits of concentration of the acid. The salt was dried, like the bisulphate, upon a plate surrounded with hot sand.

Of two different preparations,

- 0.624 salt gave 0.4864 SbS_3 and 0.571 BaOSO_3 : (I)
0.524 " " 0.4097 SbS_3 and 0.479 BaOSO_3 : (II)

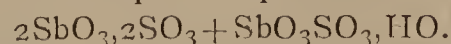
Whence their composition was

	I.	II.
	eqvts.	eqvts.
SbO_3	66.97 3.00	67.17 3.00
SO_3	31.42 5.16	31.39 5.13
HO (loss) ..	1.61 1.17	1.44 1.05
	100.00	100.00

and their formula $\text{SbO}_3.5\text{SO}_3.\text{HO}$, which requires

SbO_3	67.75
SO_3	30.86
HO	13.9
	100.00

The salt is most probably a compound of two atoms of bisulphate, and one of protosulphate—



This composition explains the facility with which it is changed by prolonged boiling, and concentration of the liquid into the bisulphate; it being only necessary that the equivalent of water be replaced by one of acid.

The crystals of this salt appear large and well defined under the microscope with medium powers. They are four-sided prisms, having for their section a rhomb with very unequal angles, and terminated by two or four faces, which, from the flatness of the prisms, are not distinctly visible: they belong apparently to the right rhombic system. Formed by the gradual concentration of the acid, they have always the same form; but by exposure of the liquid, or of a solution of the oxide in dilute acid, to the

air, crystals are obtained of the same general appearance, which seem to be of the oblique rhombic system.

By exposure for several weeks to the air of the liquid from which the prisms had separated, a fine white powder was deposited, consisting of minute irregular needles, in which, with a power of about 600, no further shape could be made out. The quantity was only sufficient for one analysis, and a subsequent attempt to form them did not succeed. 0.3447 gave 0.2668 SbS_3 and 0.2167 SO_3 .

	Calculated.	Found.
SbO_3	74.92	73.89
SO_3	20.48	21.59
HO	4.60	(4.43)
	<hr/> 100.00	<hr/> 100.00

The same salt, without the atom of water, was made by Brandes by the action of alcohol upon the neutral salt. I have obtained in this way a salt in small needles, but which was not analysed.

The last of these basic salts, the combination of two atoms of oxide with one of acid, has been described and analysed, both by Brandes and by Péligot. It is produced by the decomposition by water of the neutral salt, or its solution in dilute sulphuric acid. Precipitated from a solution, I have found it amorphous, but by standing two or three days in contact with the liquid, it crystallises in needles. According to Brandes, the amorphous salt loses the greater part of its acid by washing with water. The neutral salt, or rather the magma to which the solution of oxide of antimony in concentrated acid congeals on cooling, is resolved into minute crystalline needles, when decomposed by warm water, or when by the dilution of the acid sufficient heat is evolved. They subsided readily in the liquid, and could be boiled with repeated portions of water without changing their appearance, or the production of an amorphous substance. When brought upon a filter and washed copiously with boiling water, the filtrate contained constantly a little sulphuric acid, and deposited oxide of antimony on cooling. From the agreement of the result of their analysis with the calculated composition, it would seem that in the crystalline state, this salt is not decomposed, or is but slowly decomposed by hot water. 0.8334 of the salt prepared in this way, and dried by pressure in paper, gave 0.8393 SbS_3 and 0.2735 BaOSO_3 .

	Calculated.	Found.
2SbO_3	85.66	86.52
SO_3	11.71	11.27
HO	2.63	(2.21)
	<hr/> 100.00	<hr/> 100.00

Brandes found in the salt 3 per cent of water. Péligot obtained it water free, and also with two atoms of water. Heated to 100° it lost one half per cent; the rest of the water required for its expulsion a temperature above 240° .

The series of the sulphates of antimony resembles those of the earths glucina and zirconia, considered as sesquioxides. The neutral sulphate of neither of these earths combines with hydrate of sulphuric acid to form an acid sulphate,* and the most basic compound of both contains two equivalents of base to one of acid. In place of a bisulphate, they have salts with three atoms of acid to two of the earths, and no intermediate salt, like that of antimony, has yet been discovered. From bismuth the antimony series differs in that the salts of the former metal are decomposed by water, according to Heinz and Ruge, into basic salts containing equal equivalents of acid and base; here, also, no immediate salt is yet known. A more important difference lies in the fact that oxide of bismuth appears to form one, if not two, acid sulphates. I have analyses indicating the existence of compounds of the neutral salt with three atoms of hydrate of sulphuric acid: and also of a salt crystallising in beautiful pearly scales,

and containing equal equivalents of the neutral sulphates of bismuth and potash. A salt with three equivalents of sulphate of potash has been described by Heinz. The further account of these bodies must be reserved until their analyses have given more trustworthy results.—*American Journal of Science*, 1868.

THE SALT DEPOSITS AT STASSFURT.

By Messrs. BALD and MACTEAR.*

The southern part of the North German Basin is divided by the Hartz into two portions, which are known as the Thuringian and the Magdeburg Halberstader basins, in which salt has been raised for a lengthened period in the form of brine.

The basin covers a surface of 120 English square miles, and is filled with new red sandstone, which is not broken up by any of the older formations. It is interspersed by elevations of gypsum, which is considered a certain indication of the presence of common salt. In the Prussian mine at Stassfurt, in the Magdeburg basin, after passing through 27 feet of alluvial soil, a thickness of 576 of new red sandstone is at once reached, then 213 feet of gypsum, anhydrite, and marl, the salt being found at a depth of 816 feet. In the Anhalt mine (half a mile from the Prussian one) the sandstone is entirely wanting, the salt bed being reached at a depth of 480 feet, after passing through 20 feet of soil and 460 feet of gypsum, anhydrite, and marl. The boreholes at Schonebeck (some miles from Stassfurt) show very distinctly the various strata with which the basin is filled up as the salts gradually get deeper and deeper. Thus, at bore No. 8, the salt is 1000 feet from the surface, the intervening strata being 200 feet of alluvial soil and 800 feet of new red sandstone. At No. 5 there is 37 feet of alluvial soil, 166 feet of mussel-chalk, and 1,277 feet of new red sandstone, the salt being 1,480 feet from the surface. At No. 6 there is 30 feet alluvial soil, 877 feet mussel-chalk, and 473 feet new red sandstone, the salt being 1,380 feet from the surface. At No. 4 there is 25 feet alluvial soil, 211 feet of what in Germany is called keuper and lettenkohle (literally, copper and letten coal). This keuper is the equivalent of the saliferous and gypseous shales and sandstones of Cheshire, a member of the "Irias" or new red sandstone formation. Lettenkohle is a variety of lignite known in the district as brown coal. Next we have 1,067 feet of mussel-chalk, 377 feet of new red sandstone, and the salt at a depth of 1,680 feet. Bore No. 3 is somewhat similar to No. 4, there being 30 feet alluvial soil, 435 feet keuper and lettenkohle, 1,087 mussel-chalk, 212 new red sandstone, the salt being 1,764 feet from the surface.

In the Magdeburg basin the salt rests on new red sandstone, and in the Thuringian basin on mussel-chalk and magnesian limestone.

It is only at Stassfurt and Erfurt that the salt is mined; at all the other places it is obtained by means of brine wells, the liquor from which is concentrated by the graduation process, which consists in allowing the weak liquor to trickle through walls made of bundles of thorns and brushwood.

The graduation houses consist of a timber framing, into which the faggots or thorns are built in regular walls. The structure is covered with a roof to protect it from the rain, but the sides, of course, are open to admit of the free passage of air, which, together with the solar heat, forms the evaporating medium.

The walls are from 30 to 50 feet high, and of immense length, the celebrated one at Schonebeck being fully more than an English mile in length. They are placed in the manner best suited to obtain the full benefit of the pre-

* Zirconia, Berzelius, but perhaps not quite certain; glucina, Berzelius, and my own experiments.

* Read before the Chemical Section of the Glasgow Philosophical Society, January 18, 1868.

vailing wind. The house is divided into several sections, and the weak liquor is pumped up into a cistern, from which it is led by means of a perforated pipe along the top of the first division, down the sides of which it trickles into a large wooden tank underneath. From this it is pumped up and allowed to trickle through the second division, from underneath which it is pumped on to the third, and so on until it reaches the last one. In graduation houses, where the number of compartments does not exceed three, and, indeed, in all of them, to a greater or less extent, the liquor is pumped through the same division several times. The weak brine at Schonebeck contains $7\frac{1}{2}$ per cent of common salt, which, at the finish of the graduation process, is raised to about 22 per cent. In this state it is run into large tanks, of which there are eight at Schonebeck, of an aggregate capacity of about two and a half million gallons. From these tanks it is drawn off to the evaporating pans as required for boiling down. At these works the process of graduation can be carried on for an average of 250 days in the year.

The boring operations were commenced at Stassfurt on the 3rd April, 1839, and in June, 1843, had penetrated to the rock salt region. In January, 1851, when it had reached a depth of 1851 feet, the liquor from the bores contained—

Sulphate of magnesium	..	..	..	4.01
Chloride of magnesium	..	..	..	19.43
Chloride of potassium	..	..	..	2.24
Chloride of sodium	..	..	..	5.61
				<hr/>
Total salts	..	..	..	31.29

However, in 1848, Professor Marchand gave it as his opinion that the salts were not mixed in the manner represented by the brine, but that pure rock salt would be found at the bottom with the more soluble salts overlying it; and so much weight was given to his opinion that in December, 1851, after having penetrated to a depth of just as many feet as there were then years in the Christian Era, the sinking of the shaft "Von der Heydt" was commenced, followed in January, 1852, by that of the shaft "Von Monteuffel;" and in 1856 the pure salt was found 1,066 feet from the surface.

The shaft passes through—1st, 27 feet of alluvial soil; 2nd, 576 feet of sandstone, with some schist and grey limestone; 3rd, 192 feet of gypsum and anhydrite; 4th, 21 feet of bituminous matter mixed with anhydrite and common salt—making in all 816 feet. Next there is 158 feet of abram or potash salts, the value of which was not recognised at first, but which now play a very important part in the industry of the country. The shaft then passes through 92 feet of rock salt, the upper portion of which is rather impure, being mixed to a considerable extent with anhydrite. This makes a total depth of 1,066 feet, and at this point the lateral workings were commenced. These consist of large galleries, the principal of which are from 40 to 60 feet broad, 20 to 25 feet in height, and about 200 feet long.

The salt is wrought in a manner somewhat similar to our long wall system, a series of holes of sufficient depth, about 6 feet or so, are drilled in the face of the salt about 5 feet from the floor, and this depth of material is removed by a series of small blasts. This operation is repeated until a considerable space has been cleared under the overhanging mass of salt. Bore-holes are then drilled close to the roof, and by a series of simultaneous blasts, a large mass of salt is dislodged. In one of those halls or galleries which we visited there was lying on the floor a mass of between two and three thousand tons which had been removed in this manner a few days previously. A number of boys are employed to pick out the pieces of pure salt, which only requires grinding to fit it for domestic use. The salt is removed to the pit bottom in hutches running upon rails, exactly similar to those in use in our own coal pits. From this they are lifted to the surface by an engine of 130 horse-power, and removed to the grinding

mills, of which there are twelve at the mines. There is also a 200 horse-power engine for pumping, which lifts 13 cubic feet of water per minute.

The workings into the potash salts are opened on the other side of the shaft from the common salt galleries, for although the salts are deposited one on the top of the other, still as they dip at an angle of 30° they are all wrought from the one level.

The total thickness of the salts is 1,197 feet, and this may be said to consist of—

Rock salt	..	..	..	..	989 feet
Anhydrite	..	..	..	..	36 "
Polyhalite	..	..	..	..	13 "
Kieserite	..	..	..	..	51 "
Carnallite	..	..	..	..	98 "
Hydrated chloride of magnesium	..	..	..	..	13 "

This gives a composition of—

Chloride of sodium	..	..	..	..	85.82
Sulphate of calcium	..	..	..	..	4.88
Sulphate of magnesium	..	..	..	..	4.70
Sulphate of potassium	..	..	..	..	0.40
Chloride of magnesium	..	..	..	..	2.53
Chloride of potassium	..	..	..	..	1.67
				<hr/>	100.00

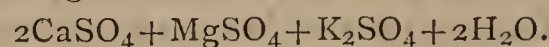
We will now consider the beds *seriatim*, beginning with the lowest, which is called the *anhydrite region*, and consists of 685 feet of pure rock salt interspersed with thin layers of anhydrite a quarter of an inch or so thick, and dividing the salt at intervals of from one to seven or eight inches. The salt is pure and colourless when pulverised.

The anhydrite is anhydrous sulphate of calcium, and contains a small quantity of a bituminous matter which imparts to it its char grey colour; traces of organic remains are also proved by the presence of a gas containing carburetted hydrogen which, according to Bischof, has the following composition:—

Carburetted hydrogen	..	..	..	85
Carbonic acid	..	..	..	3
Atmospheric air	..	..	..	12
				<hr/>
				100

It is present in quantities of about 3 c.c. per kilogramme in the rock salt and about 8 c.c. in the kali salts. It presents the appearance of air bubbles in the transparent crystals. The specific gravity of anhydrite is 2.968, and it is soluble in water to the extent of 1 part in 500.

In the second or *polyhalite region* we have, besides the common salt and sulphate of lime, a deposition, from from what might be considered the mother liquors, of the sulphates of potassium and magnesium which have combined with the sulphate of calcium to form the salt polyhalite, from which this division takes its name; its composition is given on the table:—



It has a specific gravity of 2.720 and is immediately decomposed by water. Specimens of it are seldom found pure, as they generally contain from 2 to 6 per cent of chloride of sodium. This bed is about 200 feet thick, and has an average composition, according to Steinbeck, of—

Chloride of sodium	..	..	..	91.20
Anhydrite	..	..	..	0.66
Polyhalite	..	..	..	6.33
Hydrated chloride of magnesium	..	..	..	1.51

the upper layers, however, being the more impure.

In the third or *kieserite region* the gradual disappearance of the more insoluble salts is made manifest, for it contains on an average only 2 per cent of anhydrite, and about 60 per cent of common salt, and from 17 to 20 per

cent of kieserite, which is monohydrated sulphate of magnesium, the former being— $\text{MgSO}_4 + \text{H}_2\text{O}$. Specimens found in the mine generally contain from 1 to 2 per cent of chloride of sodium or magnesium; it is amorphous, greyish white, and transparent, and in the air has a tendency to pass into epsoms, becoming opaque during the transformation; it is soluble in rather more than twice its weight of water (40.9 parts in 100 H_2O). When the quantity of water is not sufficient for complete solution this salt has the peculiar property of absorbing a certain quantity of it and setting into a hard mass, more resembling a piece of flint than anything else, and with, of course, a considerable increase of volume.

(To be continued).

ON THE CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(ADAPTED TO A JUVENILE AUDITORY),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN,

(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, Esq., M.B., F.R.S.

(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE III.

AIR—OXIDES—CARBON OR CHARCOAL.

(Continued from page 52.)

Now, carbon may exist in two states—in that in which it will burn, and in that in which it is already burnt. All our ordinary combustibles contain charcoal, but many of them—almost all indeed—also contain another substance. We know, in fact, that these substances contain charcoal, because when they burn they give rise to burnt or oxidised charcoal—that is to say, to carbonic gas; but there is another combustible called hydrogen, which is the gas known as inflammable air, and when this hydrogen burns it produces oxide of hydrogen instead of oxide of carbon, and oxide of hydrogen is water. Here is the dry hydrogen gas burning, and here is the water which is being produced by its combustion, and when, by means of magnesium wire, I illuminate the jar, you see what a very beautiful appearance is presented by the drops of the water on the sides of the glass vessel in which the combustion of the hydrogen has been going on. Well, then, as I have said, when carbon burns we get carbonic gas or oxide of carbon, and when hydrogen burns we get water or moisture produced, that water being an oxide of hydrogen, and we recognise the presence of carbon or hydrogen in a combustible by the fact that, when burning, the one produces carbonic

gas and the other water. Now, I will show you once again the production of this carbonic gas by the combustion of charcoal. We take our old test, the lime-water, and pour some of it into this glass; we then allow the air which has passed over the burning charcoal to bubble through the lime-water, and as carbonic gas is produced our lime-water turns milky. Now, instead of the current of air which we are using, we will turn a current of oxygen upon the burning charcoal, and you will see that it will then burn in a very different manner. [The experiment was performed, and the formation of carbonic gas by the combustion of the charcoal in oxygen was indicated by the clouding of the lime-water.] In this way you see that, whether we burn charcoal in oxygen or in air, the production of carbonic gas accompanies the burning.

Now let us turn our attention to some ordinary combustibles. We will first burn some ordinary coal gas from this burner, and notice what products our coal gas will furnish. To begin, we will take a bottle at present containing nothing but air, and hold it over our flame; now notice what takes place. You will first of all see that the interior of the vessel very quickly becomes dimmed or dewed with a film of water. Accordingly, coal gas by its burning produces water or oxide of hydrogen; hence we learn that the unburnt coal gas contains hydrogen. Now, does the burning of coal gas also produce carbonic acid? We shall very soon ascertain this by pouring into the bottle some lime-water, shaking it up for a minute or two, and then observing whether we convert our clear dissolved lime into insoluble chalk. [The lime-water test was applied as described.] You see that in this case chalk is produced, which shows that our coal gas contains charcoal.

As we have talked about coal gas in this way, I ought to call your attention to the manner of collecting it, and show you what sort of a substance it looks like when we get it in something like a definite quantity. I have a tube attached to the gas pipes, and from the end of this, which is under water, you see it is bubbling up, and is quite invisible. In a minute or two a jar full will be collected. It has all the appearance of ordinary air; it is quite invisible, and nobody can tell from its appearance that it contains charcoal any more than you could tell that the atmospheric air by which we are surrounded does so. Our cylinder is now filled with this ordinary coal gas, and we will proceed to set fire to it. You see the very rapid manner in which coal gas burns when it is ignited in this way.

We will next see how a candle behaves when burnt in a current of oxygen; and now I am going to call your attention to a somewhat

* Reported verbatim, by permission of the Author, for this Journal.

different phenomenon. We place a lighted candle in this glass vessel and then turn on the oxygen; the candle is now burning in a current of oxygen. Whilst it is doing so, I will cut off the supply of the ordinary air, which is also being admitted to the vessel; but you see that this does not matter in the least while the candle is supplied with a current of oxygen gas. When, however, I remove the current of oxygen, and allow the candle to burn by the aid of the ordinary air, you see a great difference; it burns very dimly, and also smokes, and in the course of a minute or two it will go out. Now how is it that the candle smokes in this way? We can make coal gas do the same, and all that we have to do to produce this effect is to treat it much in the same way—to cut off the supply of air. If we do this we find that the coal gas also will smoke. Here it is burning in the ordinary way, and now if I bring down a piece of wire gauze upon it, and cut off the supply of air thus, you observe that we get a very considerable amount of smoke.

Now, how is it that when the supply of air is cut off the burning candle and coal gas both deposit their carbon in the form of charcoal instead of yielding it in the shape of carbonic gas? Well, I will just direct your attention to the manner in which these ordinary combustibles burn in another gas, namely, chlorine—this green air, one of the properties of which is that while hydrogen burns in it very readily, carbon or charcoal does not burn in it at all, and, accordingly, if we introduce a lighted taper into it, the hydrogen of the taper burns readily, but the carbon of the taper will not burn, and therefore the flame smokes very much. You see the taper continues burning when it is introduced into the gas, but the carbon which will not burn is liberated, and appears in the form of smoke instead of being converted into invisible carbonic gas. Here is a jar containing some chlorine, to which I will add some of the coal gas, and we will now set fire to the mixture. [A light was applied to the jar, and the mixture exploded with a sharp detonation.] You see the very vigorous manner in which the coal gas burns in chlorine; but you will also observe that the sides of the jar are covered with an abundant deposit of unburnt charcoal. When these *hydrocarbon* substances burn in a sufficient supply of air, both the carbon and the hydrogen burn. The hydrogen is converted into water and the carbon into carbonic gas; but when these substances burn in chlorine instead of in air, only the hydrogen burns, and the carbon, instead of passing into the burnt condition and becoming carbonic gas, makes its appearance in the unburnt condition of soot.

Again, if instead of burning the candle or the coal gas with a sufficient supply of air,

we burn it with an insufficient quantity, the oxygen takes the hydrogen in preference, and this alone burns, the carbon being deposited without combustion. When we were burning this candle in oxygen both the hydrogen and the carbon burned, and there was no deposit of soot or charcoal; but when the charcoal burned in an insufficient supply of air, the hydrogen and carbon could not both undergo combustion: either the hydrogen alone must burn or the carbon alone, and the former did so in preference to the latter. Now, it is in this way that we generally obtain charcoal. Instead of burning the pieces of wood or materials from which charcoal is derived, with a sufficient supply of air, we burn them in an insufficient quantity, and, in that case, the hydrogen undergoes combustion, and the carbon is left unburnt. Some very beautiful forms are frequently obtained in this process. Here is some straw which was burnt in the manner I have described. The hydrogen has been consumed, and the charcoal of the straw remains in this beautiful form. Here, again, are some nuts and kernels of fruit which have been burnt into charcoal, and in the same way we obtain wood charcoal and the numerous varieties of this substance which are familiar to us. Sufficient air to burn the hydrogen is admitted, but there is not enough to combine with the carbon, and thus we get it in a separate state. There is another way in which charcoal may be obtained. At a sufficiently high temperature the hydrogen separates from the carbon without burning, and this furnishes us with another means of obtaining charcoal. In consequence of the heat which we applied to the tube of porcelain to which I drew your attention in the early part of the lecture, the coal gas which has been passing through the tube has deposited a large quantity of charcoal on the white porcelain.

So much for the methods of obtaining charcoal. We must now pass on to the consideration of some of the properties of charcoal, and the most remarkable is its extreme porosity. An ordinary piece of this substance, such as that lying on the table, has the singular property of being able to absorb very many times its volume of gas or air, and accordingly we find that what looks like a piece of charcoal, pure and simple, contains many times its own bulk of air. I can show you this by means of the air-pump. If we place some charcoal in water under the glass of the pump, and then exhaust the air, you will see bubbles of air given off. Here we have a piece of charcoal buried under water, and on working the pump we can extract the air contained in the charcoal. [The piece of charcoal was subjected to the experiment described, and gave rise to an abundant stream of bubbles when the pump was worked.] You see the large

quantity of air which has been taken up by this piece of charcoal.

Now charcoal does not absorb all kinds of air with the same facility, but it absorbs some kinds far more readily than others. Here is a table showing you the absorption which one kind of charcoal will effect in respect to different gases:—

ABSORPTIONS OF GAS BY 1 CUBIC INCH OF COCOA-NUT SHELL CHARCOAL.

Oxygen	18 cubic inches
Carbonic gas	68 ..
Sulphuretted hydrogen ..	100 ..
Ammonia gas	170 ..

A cubic inch of charcoal will absorb various quantities of different sorts of gas; but some kinds of charcoal absorb gas far more readily than others, and this is particularly the case with that obtained from the shell of the ordinary cocoa-nut. Let us consider what is the amount of gas which this form of charcoal will absorb. A cubic inch of the cocoa-nut shell charcoal can absorb 18 cubic inches of oxygen; it is, in fact, capable of absorbing the quantity of oxygen represented by this block. [The lecturer here took a piece of charcoal 1 cubic inch in size, and placed upon it a rod of deal, 1 inch square and 18 inches long. In the subsequent illustrations, rods 68 inches, 100 inches, and 170 inches long respectively, were employed to illustrate the quantities of carbonic gas, sulphuretted hydrogen, and ammonia gas absorbed by 1 cubic inch of charcoal.] Now you can scarcely form any idea of the amount of force which is required for that absorption. If we were to take 2 cubic inches of oxygen, and endeavour to compress them into the space of one, we should require the pressure of 15 lbs. weight; but to compress 18 cubic inches of oxygen into the space of 1 cubic inch, we should require eighteen times 15 lbs., which would be equivalent to about two hundredweights and a half. Here is a half hundredweight, and it is almost as much as I can lift. Now we should require about five such half hundredweights to compress 18 cubic inches of oxygen into the space of 1 cubic inch; but you must observe that the cubic inch of charcoal which can absorb these 18 cubic inches of oxygen, appears to be already full of the substance of the charcoal itself. There seems to be scarcely any space left; and what gas the charcoal will contain must occupy its pores. Now, if we imagine that the pores occupy even as much as a twentieth part of the whole mass, we should then require, not five times, but about one hundred times the pressure of this half hundredweight, to compress 18 cubic inches of oxygen into a cubic inch of charcoal. Nevertheless, so great is the absorptive power of this kind of charcoal that it gradually exerts upon the oxygen

a compressing effect equal to the force of some 50 hundredweights.

With regard to carbonic gas, it has been found that a cubic inch of charcoal is capable of absorbing 68 cubic inches of carbonic gas, or the quantity represented by this rod [placing a rod 68 inches long on the cubic inch of charcoal]. Lastly, there are two gases which are the result of the decomposition of animal matter. When animals undergo decomposition they emit two kinds of gas—one called sulphuretted hydrogen, the other ammonia. Now charcoal has the property of fixing these two gases with still greater facility; and accordingly our 1 cubic inch of charcoal can absorb 100 cubic inches of sulphuretted hydrogen gas, or the quantity which is represented by this rod. And with ammonia gas, the power of absorption is even more striking: 1 cubic inch of charcoal is able to absorb 170 cubic inches of ammonia, or the quantity represented by this other rod. And you must remember that these gases are not compressed into only 1 cubic inch of space, but into the small pores or interspaces contained in the charcoal, which seems to be solid. Thus you may form some idea of the immense force which charcoal is capable of exerting in this way.

Let me give you one or two illustrations of this property. I have, in this tube, some ammonia gas, and into this ammonia gas I will put a piece of charcoal. This is placed over mercury, and you will see that after a little while, the charcoal will gradually rise up in the tube, so as to absorb the whole of the gas, and the mercury will follow it, until the tube becomes completely full.

It is upon this remarkable absorption of different gases by charcoal that the efficacy of this substance as a respirator or ventilator depends, for it is found that when these gases are absorbed into charcoal, they have the property of acting upon one another with considerably increased activity. A striking illustration of this is afforded by the following experiment:—Here we have a glass jar, in the lower part of which is a partridge,—and I am afraid to tell you how long that partridge has been there, but at this time it is in anything but a pleasant condition. On the top of the jar is a piece of iron trellis, and on that trellis is placed some charcoal. If any one who is curious will try to smell the partridge through the charcoal he will utterly fail to detect any odour; but not only are the offensive emanations given off from the partridge—the sulphuretted hydrogen and ammonia—wholly absorbed by the charcoal, but it also absorbs the oxygen gas from the air, and these gases—the oxygen of the air, the sulphuretted hydrogen, and ammonia—at once react upon one another. The gases arising from the

partridge become burned or destroyed through the presence of the oxygen, and accordingly this action would go on for any length of time. Now, for the accommodation of any one who is still curious, there is an opening closed with a cork in the side of the jar underneath the charcoal, and if he wishes to ascertain the difference between the gases before they pass through the charcoal and after they have done so there is an opportunity for him to gratify his curiosity.

The same kind of action which enables charcoal to behave so excellently as a purifying substance, also renders it valuable as a decolourising agent. Here we have two columns of charcoal—the charcoal obtained from bone—and I want to call your attention to the decolourising effect it will produce. We have here two coloured liquids which we will pass through these columns of charcoal, and in order that you may see what change takes place, we will take two glasses of each liquid, and reserve one glass of each to enable you to see what change is produced in the liquids by their passage through the charcoal. One of these liquids is blue indigo, and the other cochineal. We will now pour one glass of each slowly through the charcoal, for the decolourising action is one which, like the absorption of the ammonia gas, takes a little time for its accomplishment. The result will be, either that the colour will entirely go, or will be diminished to such a degree that you will see a very great difference in the appearance of the liquids as they run out of the charcoal. [The filtered liquids, after passing through the charcoal, were exhibited to the audience, and found to be deprived of their colour by the filtration.]

Now, in the minute or two that remains to me I will direct your attention to the use of charcoal in charcoal filters. You see on the table two glasses of water; one of these is the water supplied to this Institution. This is, perhaps, hardly a fair sample, because, after these heavy rains, it is far more impure than usual. Here is some of the same water after it has passed through this filter, which is filled with animal charcoal, much in the same way as those in which we filtered the coloured liquids. Here are specimens of filtered and unfiltered water, and they are so placed that you can see with one eye through each tube at the same time.

On the Desulphuration of Chemical Combinations.—In this research the properties of hexanilide and its compounds with chlorhydric, nitric, sulphuric, and oxalic acids, and the analogous compounds of hexatoluide derived from toluide are examined and completed. These bodies proceed from the desulphuration of sulphocarbonilide and of sulphotoluide. The authors have also observed the action of nascent hydrogen upon these substances. The final product is aniline with the first body and of toluidine with the second. The sulphocyanogen or sulphocyanide of potassium produces sulphuretted hydrogen and methylamine.—*Journ. de Fittig*.

PROCEEDINGS OF SOCIETIES.

NEWCASTLE CHEMICAL SOCIETY.

THE second general meeting was held in the rooms of the Literary and Philosophical Society, on January 28th, and was numerously attended. In the absence of the President, the chair was occupied by John Glover, Esq.

The names of eight new members were read for the first time.

Mr. JOHN PATTINSON read a note "*On the Relation between English and Foreign Alkalimetric and Chlorimetric Degrees.*"

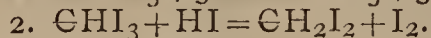
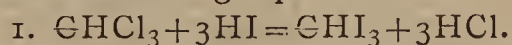
In the discussion which followed, the general feeling seemed to be that 23 should be substituted for the various incorrect values employed for sodium in some laboratories.

Mr. R. C. CLAPHAM read a paper entitled "*Some Account of the Origin of the Soda Trade on the Tyne.*"

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Conversion of Organic Chlorides into Iodides.—

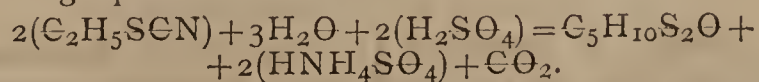
A. Lieben.—Organic chlorides are converted into iodides by the action of concentrated iodhydric acid. This method of conversion seems to be a general one, and subject to limitation only in so far as some iodides at the moment of their formation are converted into hydride. Ethyl chloride, at 130° C., is almost completely converted into iodide, without evolution of gas or formation of any by-product. The same is the case with butyl and amyl chloride. Chloroform is converted into methylene di-iodide according to the following equations:—



—(*Akad. z. Wein*, 58, 1868.)

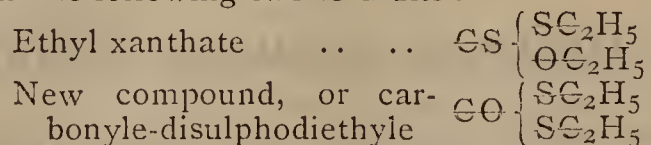
Guanidine from Chloropicrin.—A. W. Hofmann.—Guanidine may be readily prepared in large quantities by heating chloropicrin, with a strong alcoholic solution of ammonia, to 100° C. for several hours, and extracting the mixture of salts thus obtained with absolute alcohol. Guanidine nitrate, $\text{C}_2\text{H}_5\text{N}_3\text{HNO}_3$, is precipitated as a crystalline powder by adding to the chlorhydrate a solution of potassium nitrate. It forms with silver nitrate the compound $\text{C}_2\text{H}_5\text{N}_3\text{AgNO}_3$; the chlorhydrate gives with gold trichloride, $\text{C}_2\text{H}_5\text{N}_3\text{HCl} \cdot \text{AuCl}_3$. Dry guanidine chlorhydrate dissolves in aniline; on heating the solution, ammonia is given off, and the residue contains a compound of the composition of, but differing from, melaniline, $\text{CH}_3(\text{C}_6\text{H}_5)_2\text{N}_3$.—(*Deut. Chem. Ges. Berlin*, 145, 1868.)

Sulphuric Acid and Ethyl Sulphocyanate.—Schmitt and Glutz.—On acting upon ethyl sulphocyanate (1 vol.) with concentrated sulphuric acid (2 vols.) a violent disengagement of carbonic anhydride takes place, and a compound is formed which is isomeric with ethyle xanthate. To obtain it, the products of the reaction are mixed with water and distilled, when it goes over together with water as a heavy oil of the composition $\text{C}_5\text{H}_{10}\text{S}_2\text{O}$. It has the smell of garlic, is insoluble in water, soluble in alcohol, ether, and strong sulphuric acid. It boils at 196—197° C. Its formation is shown by the following equation:—



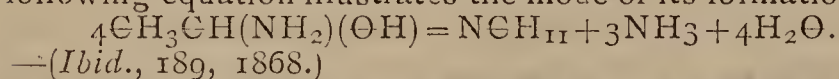
The new compound gives with alcoholic potassium hydrate—potassium carbonate and mercaptan; with alcoholic ammonia—urea and mercaptan; with water at 160°—carbonic anhydride and mercaptan. The con-

stitutional difference between it and its isomer is represented in the following two formulæ:—



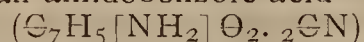
The authors have in a similar manner prepared the corresponding methyl and amyl compounds; they boil at 169° and 281° respectively. The reaction in the cases of allyle sulphocyanide and ethylene sulphocyanide seems to be of a different nature.—(*Ibid.*, 166, 1868.)

Aldehydine.—E. Ador and A. Baeyer.—If aldehyde-ammonia, urea, and ammonium acetate are heated together to 120° — 130° C., and oil of the composition $\text{N}\text{C}_8\text{H}_{11}$ =aldehydine is obtained. It floats upon water, in which it is slightly soluble; its boiling point is 175° . It smells like conine, from which it differs in composition by a minus of H_4 ; it cannot, however, be converted into the latter by the action of sodium amalgam. With chlorhydric acid, aldehydine forms a crystalline salt. The following equation illustrates the mode of its formation:—

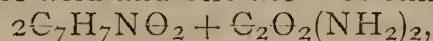


Derivatives of Hippuric Acid.—P. Griess.—1. *Oxyhippuric acid*, $\text{C}_9\text{H}_9\text{NO}_4$, is formed by boiling an aqueous solution of sulphuric-diazohippuric acid. When the evolution of nitrogen has ceased, the acid solution is neutralised with ammonia, evaporated on the water-bath, and the acid liberated by adding chlorhydric acid. It crystallises in needles, and is readily soluble in hot water, alcohol, and ether, sparingly in cold water. 2. *Iodhippuric Acid* is prepared by the action of aqueous iodhydric acid upon sulphuric-diazohippuric acid. The raw product is dissolved in ammonia, decoloured by means of animal charcoal, and precipitated with chlorhydric acid. The acid is soluble in alcohol, moderately soluble in hot water. On re-crystallisation it is obtained in large leafy crystals resembling naphthalene. Its constitution is represented by the formula $\text{C}_2\text{H}_2(\text{NH}_2)\text{O}_2$. $\text{C}_7\text{H}_4\text{IO}$; that of Maier's iodhippuric acid with which the former is isomeric, $\text{C}_2\text{HI} \cdot \text{NH}_2\text{O}_2$. $\text{C}_7\text{H}_5\text{O}$.—(*Ibid.*, 190, 1868.)

New Bases.—P. Griess.—Amongst the products of dry distillation of cyan-amidobenzoic acid—



is an oil of basic properties. After purification it crystallises in needles which fuse at 53° C., and can be distilled without decomposition. The composition of the base is $\text{C}_7\text{H}_6\text{N}_2$, and it forms well-defined salts. Another base, of the composition $\text{C}_{16}\text{H}_{18}\text{N}_4\text{O}_6 + 2\text{H}_2\text{O}$, may be obtained from $\text{C}_7\text{H}_5(\text{NH}_2)\text{O}_2 \cdot 2\text{CN}$ by boiling with a strong solution of potassium hydrate or chlorhydric acid. It crystallises with two molecules of water, which escape at 120° C., and it cannot be distilled without decomposition. It dissolves in aqueous potassium hydrate, and is precipitated therefrom by carbonic anhydride; its salts are crystalline. This base may be considered to be composed of two atoms of amidobenzoic acid and one atom of oxamide—



but it cannot be resolved into these constituents by boiling with acids or bases.—(*Ibid.*, 191, 1868.)

oils taken at random, little or no attention being paid to the time to which the oils were exposed on the water; I simply desired to show what could be done by this beautiful process. Mr. Tomlinson says that "there is a moment in the existence of every film when the characteristic figure is presented, by which it can be recognised and the purity tested." I can truly aver that such is the case, and also that our process of oleography is capable of receiving the perfect figure at the right moment and in an instant. The oleographic process needs only to be tried by any one to shew its capabilities in this way. Lard, tallow, linseed, and many other oils, produce patterns, when placed on water which there is no mistaking. Some oils develop their figures in a few seconds after they are placed on the water, and the paper we use will take up the pattern at once; so that by taking impressions of the same oil at different lengths of time, we have a series of oleographs produced which are of the greatest value in determining the purity of the oil. I am most desirous of enforcing that the period of time taken to produce a given pattern is an indispensable element in the proper testing of any oil.

Now when I set about the examination of any oil, I arrange six plates of water and let fall a drop on each, most accurately taking the time of exposure, and fixing the various patterns, so that I now have the oil in all its stages of development. For instance, take off the patterns every ten seconds up to three minutes, or beyond that time if necessary, as there are some oils which take a long time to develop their distinguishing design. Now compare these fixed patterns with those of any other oil taken under exactly similar circumstances, and the value of the test is at once manifest. Oleography is a process for fixing the patterns of oils, and thereby rendering them available for comparison.

Mr. Tomlinson appears to work much with oils of little commercial interest, as coriander, lavender, &c. Oil merchants are not as a rule interested in these oils; the oils of sperm, rape, linseed, lard, tallow, olive, cotton, and their adulterations chiefly engage their attention. In oleography we have a certain means of estimating their genuineness and in many cases their adulterants. Respecting the colours of the oil films I am almost sure no one will be ever be able to make anything of, as they are simply, I believe, the result of a property of the oil to decompose light.

For the value of oleography as a test for oils I would respectfully ask the opinion of those who are now engaged in working out results. At the request of a number of oil merchants here we are issuing an "Oleographic Album," containing the authentic oleographs of any oils desired and made by myself in the laboratory.

Some little time ago I asked a public opinion from Mr. Tomlinson regarding this process of oleography as a test for oils, and for his kindly doing so I beg heartily to thank him.—I am, &c.,

R. CARTER MOFFAT, Ph.D.

Laboratory, Mechanics' Institution, Glasgow,
Feb. 4th, 1869.

UNIFORMITY IN TAKING "IGNITING POINTS."

To the Editor of the Chemical News.

Sir,—I cordially subscribe to Mr. Hutton's remarks on the above subject in your late issue:—"Without a uniform method no two results will agree; but with a recognised method both manufacturers and merchants would know what the igniting point of the vapour of commercial substances exactly means, and a security to consumers and others that does not now exist would be obtained." Public attention having of late years been much directed to the danger attending the transit, storage, and employment of oils, spirits, and other inflammable materials, it is highly desirable that all chemists should adopt some

CORRESPONDENCE.

OLEOGRAPHS.

To the Editor of the Chemical News.

SIR,—May I be permitted to reply to Mr. Tomlinson's courteous letter in your last issue, respecting our oleographs. Mr. Tomlinson says he cannot speak favourably of the impressions I sent him as types of cohesion figures. The oleographs I transmitted to him, and also to yourself and many others, were patterns of three or four different

conventional method of determining the degree at which indefinite volatile liquids give off vapour sufficiently fast to afford a distinct flash on the approach of flame—the *igniting point, firing point, or flashing point*. Now the Petroleum Act, which came into full operation on February 1st, contains a schedule wholly devoted to “Directions for applying the flashing test to samples of petroleum oil;” this method was drawn up by Professors Abel, Letheby, and myself, is the only recognised legal process, and is, therefore, I submit, the one which should be adopted by chemists in ascertaining the firing point of liquids other than petroleum.*

In taking the flashing points of fixed oils for the Fire Offices, my colleagues, Professors Roscoe and Penny, and I employ a porcelain crucible, similar in size and shape to the test-vessel described in the Petroleum Act, and adopt the important precaution of protecting the stem of the thermometer employed by an outer glass tube; we thus arrive at tolerably concordant results.

I have appended the schedule of the new Act, as I believe it has not yet been printed in your journal. With regard to the Act itself it may be as well to observe that in the eye of the law petroleum is not petroleum if its legal flashing point is above 100° F., and no license is necessary for its sale or storage; while all mineral spirits or oils are, legally, petroleum if their flashing point is below 100° F. Traders in the latter must hold a license from one of the authorities mentioned in the Petroleum Act of 1862, and must label bottles and other vessels containing the liquid with the precautionary words mentioned in the 5th section of the Act of 1868.—I am, &c.,

JOHN ATTFIELD.

“SCHEDULE.”

“*Directions for applying the Flashing Test to Samples of Petroleum Oil.*—The vessel which is to hold the oil shall be of thin sheet iron; it shall be two inches deep and two inches wide at the opening, tapering slightly towards the bottom; it shall have a flat rim, with a raised edge one quarter of an inch high round the top; it shall be supported by this rim in a tin vessel four inches and a half deep and four and a half inches in diameter; it shall also have a thin wire stretched across the opening, which wire shall be so fixed to the edge of the vessel that it shall be a quarter of an inch above the surface of the flat rim. The thermometer to be used shall have a round bulb about half an inch in diameter, and is to be graduated upon the scale of Fahrenheit, every ten degrees occupying not less than half an inch upon the scale.

“The inner vessel shall be filled with the petroleum to be tested, but care must be taken that the liquid does not cover the flat rim. The outer vessel shall be filled with cold, or nearly cold, water; a small flame shall be applied to the bottom of the outer vessel, and the thermometer shall be inserted into the oil so that the bulb shall be immersed about one and a half inches beneath the surface. A screen of pasteboard or wood shall be placed round the apparatus, and shall be of such dimensions as to surround it about two-thirds, and to reach several inches above the level of the vessels.

“When heat has been applied to the water until the thermometer has risen to about 90° Fahrenheit, a very small flame shall be quickly passed across the surface of the oil on a level with the wire. If no pale blue flicker or flash is produced, the application of the flame is to be repeated for every rise of two or three degrees in the thermometer. When the flashing point has been noted, the test shall be repeated with a fresh sample of the oil, using cold, or nearly cold, water as before; withdrawing the source of heat from the outer vessel when the temperature approaches that noted in the first experiment, and applying the flame test at every rise of two degrees in the thermometer.”

* The apparatus may be obtained at Casella's.

ESTIMATION OF PHOSPHORUS IN IRON AND STEEL.

To the Editor of the Chemical News.

SIR,—I read with some surprise in your account of the “Proceedings of the Chemical Society” on Thursday, January 21, an observation by Dr. Miller that “the old method of estimating phosphorus (in iron and steel), which involved the throwing it down as iron-salt, was unreliable.”

For many years I have been in the habit of using this method, which I regard as quite as accurate as the phospho-molybdate process of Eggertz and not nearly so tedious.

I am constantly engaged in the determination of phosphorus and phosphoric acid in iron and iron ores; every process that has been recommended has been submitted by me to the most careful examination, and I have rejected all in favour of the old plan, which, I am confident will, if carefully executed, satisfy the requirements of the most fastidious chemist.

Among the precautions necessary to insure accuracy when dealing with iron and steel containing very small amounts of phosphorus may be mentioned that of not operating on too bulky solutions. When estimating phosphorus in iron and steel, I work on from 75 to 100 grains, and the solution, at the time of adding the tartaric (or citric) acid, ammonia, and sulphate of magnesia, is never allowed to exceed in volume 3 fluid ounces. The first precipitate always carries down a little iron, which is removed by re-solution and re-precipitation after the addition of a fresh small quantity of tartaric acid. I never collect the first precipitate till after the liquid has stood for twenty-four hours; the second precipitate is quite white, and may be filtered off after half an hour, and I am quite confident, from very long experience, that it contains the whole of the phosphoric acid. I have recently been using this method in cases where the amount of phosphorus has not exceeded 0.02 per cent.

I do not say that the phosphate of iron process is superior in point of accuracy to the phospho-molybdate process, but I do assert that it is quite as trustworthy and far less troublesome.—I am, &c.,

HENRY M. NOAD.

St. George's Hospital,
Feb. 1, 1869.

MISCELLANEOUS.

Optical Glass.—Messrs. Chance are now making optical glass of a density of 4.4.

Testing of Glycerin for Sugar and Dextrin.—To 5 drops of the glycerin to be tested add 100 to 120 drops of water, 3 to 4 centigrammes of ammonium molybdate, 1 drop of pure nitric acid (25 per cent), and boil for about a minute and a half. If any sugar or dextrin is present the mixture assumes a deep blue colour.—(*Polyt. Notitzbl.*, 143, 1868).

New Alkaloid in Fermented Liquors.—According to M. Oser, every time that solutions of sugar ferment under the influence of yeast, besides alcohol, a new alkaloid is produced, to which the author attributes the formula, $C_{26}H_{20}N_4$. The chlorhydrate of this base crystallises in hygroscopic tables, which become brown on exposure to the air. It appears that all fermented liquors contain the new alkaloid, or at least one of its compounds. We await further information on this subject; the presence of such a substance in wine and in beer, till now entirely unknown, will doubtless explain certain effects of fermented liquors on the animal economy, effects which cannot be attributable to alcohol alone.—*Cosmos*.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News." A more complete list containing the omitted papers and contents of journals devoted to other branches of science, is published at the Patent Office, in the library of which the periodicals themselves may be consulted.)

Comptes Rendus.

November 9, 1868.

A. W. HOFMANN, "On the Compounds Isomeric with the Sulphocyanic Ethers: Homologues and Analogues of Oil of Mustard of the Ethylic Series." SECCHI, "Note on Solar Protuberances." JAMIN, "On the theory of Scintillation." CHEVREUL, on the same subject. FIZEAU, "Note on A. J. Angström's 'Maps of the Solar Spectrum.'" J. N. LOCKYER, "Further Remarks on the Author's Method of obtaining Spectra of the Solar Protuberances." F. M. RAOULT, "On the Effect of a Rise in Temperature on the Caloric Phenomena accompanying Electrolysis." BERTHELOT, "On the Pyrogenous Formation of the Acetylene of the Benzol Series." LEFRANC, "On Atractylic Acid and the Atractylates, some new Products extracted from *Atractylis gummifera*." G. FLEURY, "A method of Preparing Emetics and other Double Tartrates." A. COMMAILLE, "On the Presence of Creatine in Putrefied Whey."

November 16, 1868.

A. W. HOFMANN, "On the Compounds Isomeric with the Sulphocyanic Ethers:—Comparison of the Metamorphoses of Oils of Mustard and of the Sulphocyanic Ethers." WARREN DE LA RUE, "Note on a Photograph of the Sun." A. SCHEURER-KESTNER and C. MEUNIER, "Researches on the Combustion of Coal." (Continuation.)

Bulletin de l'Académie Royale de Belgique. (Classes des Sciences.)
October 10, 1868.

STAS, "Report on B. Radziszewski's Memoir on some Derivatives of Phenyl-Acetic Acid." B. RADZISZEWSKI, "Researches on some Derivatives of Phenyl-Acetic Acid." C. BLAS, "On the Fluorescent and other Properties of Murrayine, a new Glucoside obtained from *Murraya exotica*."

Poggendorff's *Annalen der Physik*.
October 12, 1868.

C. PAPE, "On the Thermal and Chemical Axes of Gypsum and Sulphate of Copper." E. WARBURG, "Observations on the Influence of Temperature on Electrolysis." W. BEETZ, "On the Electric Vibration-Chronoscope." PINCUS, "On a New Constant Voltaic Battery." A. WULLNER, "A Method of obtaining an Artificial Spectrum with a single Fraunhofer's Line."

NOTES AND QUERIES.

The New Petroleum Act.—Can any of the numerous correspondents of the CHEMICAL NEWS tell us if benzol comes under the operation of the act. If it does, it will affect us rather seriously. We presume ether is not included.—A WHOLESALE FIRM.

Manufacture of Iron.—A new process for the manufacture of iron, whereby the puddling process is obviated, is now on its trial at Pittsburgh, U.S. The pigs of crude iron are melted, and while in a fused state, a quantity of crushed ore is intermixed. The oxygen of the ore combines with the carbon of the iron; the mixed mass is called a pig bloom. Upon re-heating these pigs and squeezing them in the usual manner, iron of very good quality is obtained.—*Engineer*.

Chromium Steel.—It has long been known that an alloy composed of sixty parts of chromium and forty parts of iron is so hard as to scratch glass like a diamond, and such an alloy may be formed by heating oxide of chromium and also chrome iron ore in a blast furnace; if the oxide alone be applied, metallic iron, of course, should be added. Experiments on the large scale are now being carried on to produce a species of steel, suitable for rails and other purposes, by adding chrome ore and manganese to the iron in the puddling furnace.—*Engineering*.

Colouring Zinc.—Zinc may be given a fine black colour by cleaning its surface with sand and dilute sulphuric acid, and then immersing it for an instant in a solution composed of four parts of sulphate of nickel and ammonia in forty parts of water acidulated with one part of sulphuric acid, next washing and drying it. The black coating adheres firmly, and takes a bronze colour under the burnisher. Brass may be stained black with a liquid containing two parts arsenious acid, four of hydrochloric acid, one of sulphuric acid, and eighty of water.

Preservation of Wood.—According to statements made by Dr Feuchtwanger, of New York, who for the past thirty-six years has had his attention directed to the preservation of wood from every species of decay, and also to make it incombustible or fire-proof, not one single process attempted for this purpose has been attended with permanent success, except the application of silicates in their various forms to all organic substances, such as woody fibre, pasteboard, &c. Dr. Feuchtwanger's method is simply to steam the timber, then inject a solution of silicate of soda for eight hours, and then soak the wood for the same period in lime-water.

The Specific Gravity of Steel oxallates between 7.2 and 7.9. The hardening of the metal by tempering is accompanied, as Réaumur long ago observed, by a notable diminution of specific gravity, and Caron has noted that the specific gravity of steel diminishes with the number of times it is tempered.

MEETINGS FOR THE WEEK.

MONDAY, 8th.—Medical, 8.

London Institution, 8.

TUESDAY, 9th.—Royal Institution, 3. Mr. Westmacott, "On Fine Art."

Photographic, anniversary, 8.

WEDNESDAY, 10th.—Society of Arts, 8.

Geological, 8. E. Hull, Esq., B.A., F.G.S., "On a Ridge of Lower Carboniferous Rocks crossing the Plain of Cheshire." Rev. T. Wiltshire, M.A., F.G.S., "On the Red Chalk of Hunstanton." W. Boyd Dawkins, Esq., M.A., F.G.S., "On the British Postglacial Mammalia."

Microscopical, anniversary, 8.

THURSDAY, 11th.—Royal Institution, 3. Dr. M. Foster, "On the Involuntary Movements of Animals."

London Institution, 6

Royal, 8.30.

Zoological, 8.30.

Royal Society Club, 6.

FRIDAY, 12th.—Royal Institution, 8. Colonel Drummond Jervoise, "On the Coast Defences of England."

Astronomical, 8; anniversary, 3 p.m.

SATURDAY, 13th.—Royal Institution, 3. Dr. Odling, F.R.S., "On Hydrogen and its Analogues."

TO CORRESPONDENTS.

* * VOL. XVIII. of THE CHEMICAL NEWS, containing a copious index, is now ready, price 11s., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes, are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xix. commenced on January 1st, and will be complete in twenty-six numbers. It will contain a verbatim report of Dr. Odling's Juvenile Lectures at the Royal Institution "On the Chemical Changes of Carbon," and original papers from some of our leading English and Foreign Chemists and Physicists.

Reprints of our Early Numbers.—In deference to the wishes of numerous subscribers, we have decided to re-issue many of our earlier numbers which have long been out of print, and in this manner we shall shortly be able to supply all the earlier volumes. No. 3, December 24, 1859, will be ready for issue in about a week's time.

A. W. A.—We cannot recommend any particular chemist in this column. Send a private address, with particulars, and we will communicate with you.

W. Cass.—The whole of the information you require respecting the best and most modern works on iron, its nature and working, &c., will be found in the second volume of Kerl's "Metallurgy," which will be published in the course of a month or two by Messrs. Longmans.

Phosphoric Acid.—A correspondent who makes some remarks on this subject, is informed that his letter is so badly written as to be almost unintelligible. The signature is hopelessly involved in flourishes, and it is only here and there that a word can be deciphered.

F. D.—Beside the works quoted last week, there are several others, chiefly in the German language, giving descriptions of laboratories. There are, for instance, descriptions of the laboratories of Giessen, Carlsruhe, Prague, Upsala, Dorpat; in the German edition of Mohr's excellent work *Pharmaceutische Technik* an entire chapter is devoted to the subject of arranging and fitting up a laboratory, while Dr. Adolf Duflos, of Breslau University, has also written and published a small, but very excellent, work on this subject.

Communications have been received from A. Freire Marreco; R. Mallet, F.R.S.; R. Carter Moffat; C. Griffin and Co.; S. Mellor; C. Greville Williams, F.R.S.; Dr. Adriani; W. Palmer; H. Russell; J. E. Morgan; Dr. Letheby; E. Blackwell; W. Sydney Gibbons, Melbourne; R. C. Clapham; Clarke and Company, Melbourne; Professor Horsford; R. R. Tatlock; W. Cass; Archibald Walker and Co. (with enclosure); Mawson and Swan; J. S. Brazier; F. Baden Benger; H. Hudson (with enclosure); A. Deiss (with enclosure); J. Hopkinson (with enclosure); Rev. R. C. Jones (with enclosure); Sturge and Co.; E. A. Sturman; The Kew Observatory; A. Geyger; W. Browning (with enclosure); Runcorn Soap and Alkali Co.; J. Turner (with enclosure); and W. Little (with enclosure).

BOOKS RECEIVED.

Town Life among the Poorest: the Air they Breathe and the Houses they Inhabit. By John Edward Morgan, M.A., M.D., Oxon. London: Longmans, Green, and Co.

Report on the Sanitary Condition of the City of London for the year 1867-68. By H. Letheby, M.B., M.A., Ph.D., &c.

The American Journal of Science, January 1869.

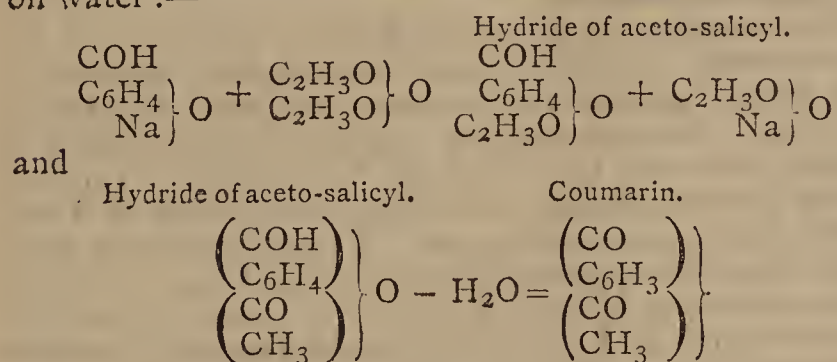
THE CHEMICAL NEWS.

VOL. XIX. No. 480.

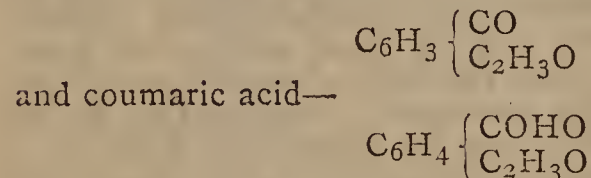
ON THE CONSTITUTION OF COUMARIN, COUMARIC ACID, AND MELILOTIC ACID.*

By Prof. RUDOLPH FITTIG.

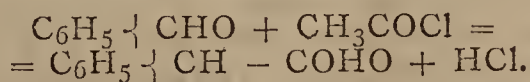
At the conclusion of his very interesting treatise on the artificial production of coumarin (*Journ. of Chem. Soc.*, vol. vi., p. 53), Perkin develops his views on the formation and constitution of coumarin and coumaric acid. He assumes that in this reaction the hydride of aceto-salicyl, at a later date prepared by him (*Journ. of Chem. Soc.*, vol. vi., p. 181), at first results, and that this then gives off water:—



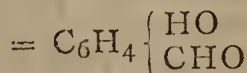
Coumarin would thus have the constitution—



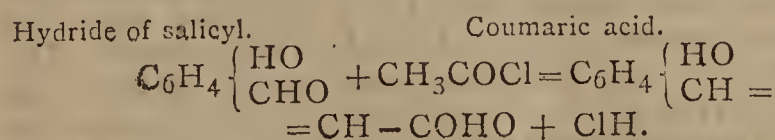
These formulæ, however, do not at all correspond with the behaviour of the two compounds, and at first sight even it appears improbable that an atom of hydrogen from the benzol residue should be used to the formation of water in the artificial production of coumarin. According to my view it is exceedingly probable that the reaction discovered by Perkin takes place in the same way as that discovered by Bertagnini in the artificial preparation of cinnamic acid from oil of bitter almonds and chloride of acetyl—



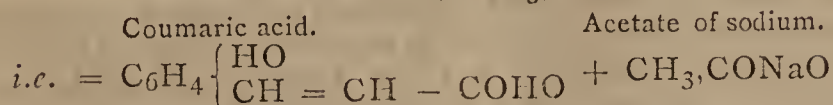
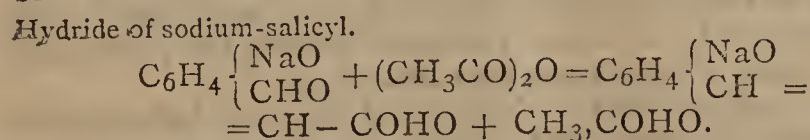
As hydride of salicyl is identical with hydride of oxybenzoyl—



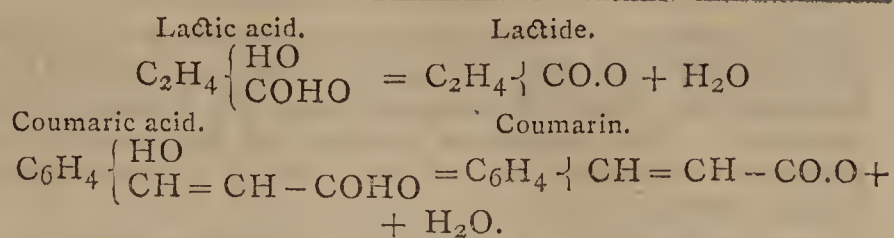
it must give in the same reaction oxycinnamic acid, i.e. coumaric acid—



or—

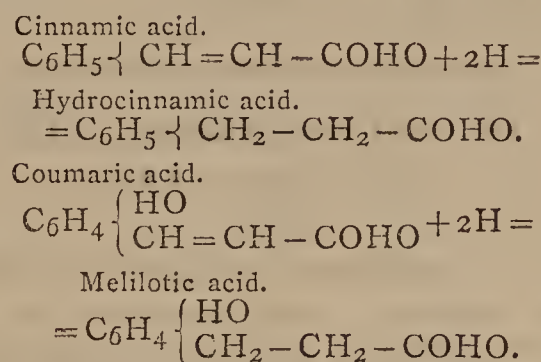


At the high temperature, and by the excess of the anhydride, the resulting coumaric acid is decomposed in the same manner as lactic acid by its transition into lactide, in the anhydride, i.e., coumarin and water—



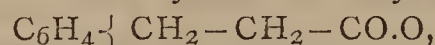
According to this, coumarin is the anhydride of coumaric acid, and its easy transition into this acid, in being treated with potassa, can be easily understood. The decomposition of coumaric acid into salicylic and acetic acid, speaks highly in favour of the view that its constitution is similar to that of cinnamic acid, and that it stands to this in the same relation as salicylic acid to benzoic acid.

By treatment with hydrogen *in statu nascendi*, coumaric acid is converted into melilotic acid, the same as cinnamic acid is converted into hydrocinnamic (phenylpropionic) acid—



Melilotic acid is, according to this, oxyphenylpropionic acid. It differs from phenyllactic acid (Glaser) only in this that the HO replaces an atom of hydrogen in the benzol residue, while in the phenyllactic acid it stands in the place of an atom of hydrogen in the group CH₂ of the propionic residue.

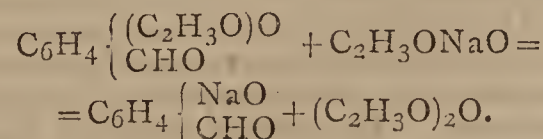
Heated, melilotic acid yields the anhydride—



(Zwenger), i.e., hydrocoumarin, which must also result by adding hydrogen to coumarin, if the conversion of the anhydride into the acid can be prevented.

The views on the formation of coumarin, expressed above, explain also thoroughly the observation by Perkin, that by treating the hydride of aceto-salicyl with acetic anhydride there results no coumarin, a fact perfectly incomprehensible, if we assume with Perkin, that the artificial production of coumarin is a result merely of the abstraction of water from the hydride of aceto-salicyl. Perkin has further observed the interesting fact, that coumarin results when hydride of aceto-salicyl is heated with acetic anhydride with an addition of acetate of sodium. According to Perkin's view, the influence of the acetate of sodium is perfectly incomprehensible, inasmuch as it is impossible that acetate of sodium or a compound of this salt with acetic anhydride could have a stronger dehydrating influence than the anhydride, a fact which Perkin himself remarks.

According to my view, the action of the acetate of sodium consists in this—that at an elevated temperature it at first gives rise to a reversed reaction, i.e., that it forms acetic anhydride and hydride of sodium-salicyl again—

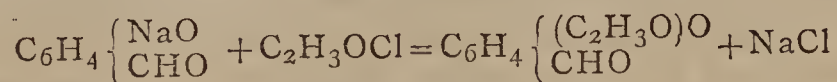


The acetic anhydride acts only on this regenerated hydride of sodium-salicyl in the above-mentioned manner and forms coumaric acid, which, in its turn, breaks up into coumarin and water. This reaction explains, at the same time, why hydride of aceto-salicyl can be prepared only at a low temperature.

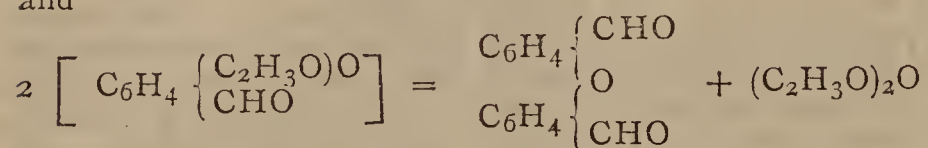
Another reaction observed by Perkin may be explained in the same way; Perkin could not obtain hydride of aceto-salicyl by the action of chloride of acetyl on the hydride of sodium-salicyl. Instead of this the hydride of

* Communicated by the Author.

disalicyl resulted; but it is incomprehensible why hydride of aceto-salicyl should not result in this way, and, in fact, Cahours has prepared this compound by means of this method. The hydride of disalicyl of Perkin is only a product of decomposition of the hydride of aceto-salicyl at first formed—



and



and this reaction exhibits very clearly the tendency of the hydride of aceto-salicyl to give off acetyl at an elevated temperature. It makes the action of acetate of sodium, as assumed above, very probable.

Göttingen, Jan. 1869.

ON HYDROFLUORIC ACID.*

By G. GORE, F.R.S.

A. Anhydrous Hydrofluoric Acid.

THIS paper contains a full description of the leading physical and chemical properties of anhydrous hydrofluoric acid, and also an account of various properties of pure aqueous hydrofluoric acid. The author obtained the anhydrous acid by heating dry double fluoride of hydrogen and potassium to redness in a suitable platinum apparatus (shown by a figure accompanying the paper), and states the conditions under which it may be obtained in a state of purity.

The composition and purity of the anhydrous acid are shown and carefully verified by various methods of analysis, both of the double fluoride from which it was prepared and of the acid itself; and particulars are given of all the circumstances necessary to ensure reliable and accurate results. Nearly all the operations of preparing, purifying, analysing, and examining the properties of the acid were conducted in vessels of platinum, with linings of paraffin, sulphur, and lampblack; articles of transparent and colourless fluor-spar were also employed in certain cases. Nearly all the manipulations with the acid were effected while the vessels containing it were immersed in a strong freezing-mixture of ice and crystallised chloride of calcium.

The pure anhydrous acid is a highly dangerous substance, and requires the most extreme degree of care in its manipulation. It is a perfectly colourless and transparent liquid at 60° Fahr., very thin and mobile, extremely volatile, and densely fuming in the air at ordinary temperatures, and absorbs water very greedily from the atmosphere. It was perfectly retained in platinum bottles, the bottle having a flanged mouth with a platinum plate secured with clamp-screws, and a washer of paraffin.

A number of attempts were made, finally with success, to determine the molecular volume of the pure anhydrous acid in the gaseous state, the acid in these cases being prepared by heating pure anhydrous fluoride of silver with hydrogen in a suitable platinum apparatus over mercury. Particulars are given of the apparatus employed and of the manipulation. The results obtained show that one volume of hydrogen, in uniting with fluorine, produces not simply one volume of gaseous product as it does when uniting with oxygen, but two volumes, as in the case of its union with chlorine. The gaseous acid transferred to glass vessels over mercury did not corrode the glass, or render it dim in the slightest degree during several weeks, provided moisture was entirely absent.

The author concludes that the anhydrous acid he has obtained is destitute of oxygen, not only from the various

analyses and experiments already referred to, but also, 1st, because the double fluoride from which it was prepared, when fused and electrolysed with platinum electrodes, evolved abundance of inflammable gas at the cathode, but no gas at the anode, although oxides are by electrolysis decomposed before fluorides; 2nd, because the electrolysis of the acid with platinum electrodes yielded no odour of ozone, whereas the aqueous acid of various degrees of strength evolved that odour strongly; and, 3rd, because the properties of the acid obtained from the hydrogen and fluoride of silver agree with those of the acid obtained from the double salt. He considers, also, that the acid obtained from pure fluor-spar and monohydrated sulphuric acid heated together in a platinum retort is free from oxygen and water.

The specific gravity of the anhydrous liquid acid was several times determined, both in a specific-gravity bottle of platinum, and also by means of a platinum float submerged and weighed in the acid. Concordant and reliable results were obtained; the specific gravity found was 0.9879 at 55° Fahr., that of distilled water being = 1.000 at the same temperature.

The anhydrous acid was much more volatile than sulphuric ether. Its boiling-point was carefully determined, in a special apparatus of platinum, and was found to be 67° Fahr. Not the slightest sign of freezing occurred on cooling the acid to -30° Fahr. (= -34.5 C.); and it is highly probable that its solidifying temperature is a very great many degrees below this. Its vapour-tension at 60° Fahr. was also approximately determined, and was found to be = 7.58 lbs. per square inch. On loosening the lid of a bottle of the acid at 60° Fahr., the acid vapour is expelled in a jet like steam from a boiler; this, together with the low boiling-point, the extremely dangerous and corrosive nature of the acid, and its great affinity for water, illustrates the very great difficulty of manipulating with it and retaining it in a pure state. Nevertheless, by the contrivances described, and by placing the bottles in a cool cellar (never above a temperature of 60° Fahr.), the author has succeeded in keeping the liquid acid perfectly, without loss, and unaltered, through the whole of the recent hot summer.

The electrical relations of different metals, &c, in the acid were found to be as follows at 0° Fahr.:—Zinc, tin, lead, cadmium, indium, magnesium, cobalt, aluminium, iron, nickel, bismuth, thallium, copper, iridium, silver, gas-carbon, gold, platinum, palladium.

Numerous experiments were made of electrolysing the anhydrous acid with anodes of gas-carbon, carbon of lignum-vitæ, and of many other kinds of wood, of palladium, platinum, and gold. The gas-carbon disintegrated rapidly: all the kinds of charcoal flew to pieces quickly, and the anodes of palladium, platinum, and gold were corroded without evolution of gas. The acid with a platinum anode conducted electricity much more readily than pure water; but with one of gold it scarcely conducted at all. These electrolytic experiments presented extreme difficulties, and were conducted in a platinum apparatus (shown by a figure) specially devised for the purpose. The particulars of the conditions and results obtained are described in the paper. Various mixtures of the anhydrous acid with monohydrated nitric acid, with sulphuric anhydride, and with monohydrated sulphuric acid, were also electrolysed by means of platinum anodes, the particulars and results of which are also described.

To obtain an idea of the general chemical behaviour of the pure anhydrous acid, numerous substances (generally anhydrous) were immersed in separate portions of the acid in platinum cups, kept at a low temperature (0° to -20° Fahr.). The acid had scarcely any effect upon any of the metalloids or noble metals, and even the base metals in a state of fine powder did not cause any evolution of hydrogen. Sodium and potassium behaved much the same as with water. Nearly all the salts of the alkali- and alkaline earth-metals produced strong chemical action. Various anhydrides (specified) dissolved freely. Strong aqueous

* Abstract of a paper read before the Royal Society, January 28th, 1869.

hydrochloric acid produced active effervescence. The alkalis and alkaline earths united strongly with the acid. Peroxides gave no effect. Numerous oxides (specified) produced strong chemical action, some of them dissolving. Some nitrates were not chemically affected, others (those of lead, barium, and potassium) were decomposed. Fluorides generally were unchanged, but those of the alkali-metals and of thallium produced different degrees of chemical action, those of ammonium, rubidium, and potassium uniting powerfully. Numerous chlorides were also unaffected, whilst those of phosphorus (the *solid* one only), antimony (the perchloride), titanium, and of the alkaline earth- and alkali-metals, were decomposed with strong action, and generally with effervescence. The chlorates of potassium and sodium were also decomposed with evolution of chloric acid: the bromides of the alkaline earth- and alkali-metals behaved like their chlorides. Bromate of potassium rapidly set free bromine. Numerous iodides were unaffected, but those of the alkaline earth- and alkali-metals were strongly decomposed, and iodine (in some cases only) set free. The anhydrous acid decomposed all carbonates with effervescence, and those of the alkaline earth- and alkali-metals with violent action. Borates of the alkalis also produced very strong action. Silico-fluorides of the alkali-metals dissolved with effervescence. All sulphides, except those of the alkaline earth- and alkali-metals, exhibited no change; the latter evolved sulphuretted hydrogen violently. Bisulphite of sodium dissolved with effervescence. Sulphates were variously affected. The acid chromates of the alkali-metals dissolved with violent action to blood-red liquids, with evolution of vapour of fluoride of chromium. Cyanide of potassium was violently decomposed, and hydrocyanic acid set free. Numerous organic bodies (specified) were also immersed in the acid; most of the solid ones were quickly disintegrated. The acid mixed with pyroxylic spirit, ether, and alcohol, but not with benzol; with spirit of turpentine it exploded, and produced a blood-red liquid. Gutta percha, india-rubber, and nearly all the gums and resins were rapidly disintegrated and generally dissolved to red liquids. Spermaceti, stearic acid, and myrtle wax were but little affected, and paraffin not at all. Sponge was but little changed. Gun-cotton, silk, paper, cotton wool, calico, gelatine, and parchment were instantly converted into glutinous substances, and generally dissolved. The solution of gun-cotton yielded an inflammable film on evaporation to dryness. Pinewood instantly blackened.

From the various physical and chemical properties of the anhydrous acid, the author concludes that it lies between hydrochloric acid and water, but is much more closely allied to the former than to the latter. It is more readily liquefied than hydrochloric acid, but less readily than steam; like hydrochloric acid it decomposes all carbonates; like water it unites powerfully with sulphuric and phosphoric anhydrides with great evolution of heat. The fluorides of the alkali-metals unite violently with hydrofluoric acid, as the oxides of those metals unite with water; the hydrated fluorides of the alkali-metals also, like the hydrated fixed alkalis, have a strongly alkaline reaction, and are capable of expelling ammonia from its salts. It may be further remarked that the atomic number of fluorine lies between that of oxygen and chlorine; and the atomic number of oxygen, added to that of fluorine, nearly equals that of chlorine.

B. Aqueous Hydrofluoric Acid.

Under the head of the aqueous acid the author enumerates the various impurities usually contained in the commercial acid, and describes the modes he employed to detect and estimate them, and to estimate the amount of H F in it. The process employed by him for obtaining the aqueous acid in a very high degree of purity from the commercial liquid is also fully described. It consists essentially in passing an excess of sulphuretted hydrogen through the acid, then neutralising the sulphuric and hydrofluosilicic acids present by carbonate of potassium,

decanting the liquid after subsidence of the precipitate, removing the excess of sulphuretted hydrogen by carbonate of silver, distilling the filtered liquid in a leaden retort with a condensing tube of platinum, and, finally, rectifying.

The effect of cold upon the aqueous acid was briefly examined, the result being that a comparatively small amount of hydrofluoric acid lowers the freezing-point of water very considerably.

The chemico-electric series of metals, &c., in acid of 10 per cent and in that of 30 per cent were determined. In the latter case it was as follows:—Zinc, magnesium, aluminium, thallium, indium, cadmium, tin, lead, silicon, iron, nickel, cobalt, antimony, bismuth, mercury, silver, copper, arsenic, osmium, ruthenium, gas-carbon, platinum, rhodium, palladium, tellurium, osmi-iridium, gold, iridium. Magnesium was remarkably unacted upon in the aqueous acid. The chemico-electric relation of the aqueous acid to other acids with platinum was also determined.

Various experiments of electrolysis of the aqueous acid of various degrees of strength were made with anodes of platinum. Ozone was evolved; and with the stronger acid only, the anode was corroded at the same time. Mixtures of the aqueous acid with nitric, hydrochloric, sulphuric, selenious, and phosphoric acids were also electrolysed with a platinum anode, and the results are described.

ON FOOD.*

By DR. LETHEBY, M.A., M.B., &c.

(Continued from p. 32.)

Unwholesome and Adulterated Food.

As regards the injurious quality of meat infected with parasitic disease there can be no question; and, perhaps, of all such infections, the most terrible is the *trichina* of pork. Fortunately, it is a rare affection in this country, although it is often common in Germany. The pork infected with the worm is generally darker than usual, on account of the irritating or inflammatory action of the creature lodged in the muscles; and when the parasite is encysted the meat presents a speckled appearance—the minute white cysts containing the worm being just visible to the naked eye. Here are specimens of it in both its encysted and non-encysted conditions; and this diagram represents the appearance of the worm when it is examined under the microscope. It is, as you see, a minute thread-like worm, about the thirtieth of an inch in length, coiled up in a spiral form; hence its name, *trichina spiralis*. It is generally found in the human subject in an encysted state, when it has passed beyond its dangerous condition and has become harmless. In most cases, when thus discovered, there is no record of its action, and therefore it was once thought to be an innocent visitor; but we now know that while it was free—that is, before nature had barricaded it up in the little cyst, its presence was the cause of frightful disorder—killing about 50 per cent of its victims in terrible agony. In Germany, there have been frequent outbreaks of the disease, which, for a time, baffled the skill of the most experienced physicians; in fact, we hardly know how long or how often the disease has attacked the pork-feeding population of Europe, for its actual nature was unknown until the year 1860, when Dr. Zencker, of Dresden, discovered the pathology of the disease. Since then there have been several visitations of it, as at Plauen, in Saxony, in 1862; at Hettstadt, near Eisleben, in 1863; and at Hedersleben, near Magdeburg, in Prussian Saxony, in 1866. In all these

* The Cantor Lectures, delivered before the Society of Arts.

cases the same symptoms, or nearly the same were observed; there was sometimes immediate disturbance of the digestive functions, but more commonly a day or two elapsed before any particular symptom was noticed, and then there was a feeling of lassitude, with a loss of appetite, and pains in the head and back. Then followed a serious disturbance of the alimentary canal, with vomiting and diarrhoea. This lasted for a day or two; and by the end of a week after the worm had been eaten fever had set in, which became more and more severe, and by that time the young worms which had been hatched in the body had migrated to the distant muscles, causing the most excruciating pains, so that the patient, fearing to move his inflamed muscles, would lie motionless upon his back; and if he did not die in this state of the disorder nature came to the rescue, and imprisoned the creature by surrounding it with a fibrinous cyst, where it lives for years, being ready at any moment to acquire activity when it is swallowed and released from its cell. Indeed, the way in which it becomes dangerous is this—flesh infected with the parasite is eaten; and the cyst being quickly dissolved by the gastric juice, the creature is set free. Finding itself in the midst of nourishing food it rapidly grows, so that in two or three days it is three or four times its original size, and may be easily seen, like a bit of fine thread, with the naked eye. The worms are of different sexes, and they rapidly come to maturity—each female giving birth to from 300 to 500 minute thread-like worms, which immediately set out upon their travels, piercing the walls of the intestines and migrating to distant parts of the body, where they produce the terrible mischief I have described. Although the pig is the animal which is most commonly infested by it, yet it has been found in the muscles of dogs, foxes, badgers, sheep, moles, hedgehogs, rats, mice, frogs; and most carnivorous birds, all of which must have been subjects of the disease, but none appear to suffer from it like man; even children are less affected by it, for they seem to sleep it away. Fortunately, there is an easy method of discovering its presence in animals, for the most certain seat of the creature is in the muscles of the eye; we have therefore only to examine these muscles with the microscope to declare whether the meat is infected or not; and, at the present time, the sausage makers of Germany have the pork examined in this manner before it is used for food.

Other parasitic creatures, as measles in pork, and the smaller *cysticerci* of beef and veal, are found as little sacs or bladders diffused through the lean of the meat—the *cysticercus* or measles of pork being easily seen, for it is as large as a hemp-seed. Here are specimens of it in a fresh condition, which were seized in the City markets to-day; but the *cysticercus* of other animals is much smaller, and requires careful exploration to discover it. In both cases the sac contains a little creature with a sort of tuberculated head, crowned with a coronet of hooks, and having a bladder-like tail attached to it. Soon after it is swallowed, the enclosing sac is dissolved by the gastric juice, and the creature being liberated passes into the intestines, and there fixes itself by its little hooks, and quickly grows, joint after joint, into a tape-worm. In the case of the *cysticercus* of pork, it forms the variety of tape-worm called *tenia solium*, and in that of beef and veal it produces the *tenia mediocanellata*. The latter is the most common variety of it in the human intestines, and it is frequently seen where raw, or nearly raw, meat is made use of, as in Abyssinia and in Russia, where children are allowed to suck a piece of raw beef, on the supposition that it has a strengthening property. Each segment of the worm is an independent creature, containing myriads of ova, and when passed by the bowels, it gets with the manure upon the land and is eaten by pigs, oxen, and goats; the ova are then hatched in the stomach, and they pass, as in the case of the *trichinia* through the walls of the intestine, and migrate to the muscular tissues of the body, where they become encysted, and form the little sacs or measles, which remain dormant for years, though they are ever ready to become tape-worms

directly they are eaten. In this manner the creature is perpetuated, first as a tape-worm 'with joints in the intestines of one animal, and then as a measles or larva in the muscle of another, and then again as a tape-worm. By a like process the *tenia chinococcus*, or little tape-worm of the dog, becomes the hydatid in man and other animals. In Iceland the dogs are very liable to this infection, and the cattle and sheep, as well as man, suffer from the hydatid of it. The subject has been well investigated by Dr. Leared, who has shown that the practice of giving the diseased offal of the slaughtered animals to dogs causes tape-worm, and the dogs drop the segments of the worm filled with ova, upon the pastures and into running water. By this means they enter the bodies of cattle and sheep, and even of man, and then, as in the last case, the ova quickly become developed, and the young hydatid or larva tape-worm, piercing the walls of the alimentary canal, migrates to distant parts, and finding a suitable nidus for its growth, it slowly becomes a large bladder-like hydatid. In the case of the sheep it often selects the brain for its habitat, and produces the disease called staggers; in the oxen it grows in the peritoneal cavity; and in man it haunts the liver, occasioning frightful disturbance of the system, and causing one-sixth of the total mortality of that country. Here are specimens of the disease from the human subject.

Again, there is another class of parasite, called *trematoda* or flukes, which infest the livers and intestines of men and herbivorous animals. The most common of them is the *distoma hepaticum* or liver-fluke of the sheep. In wet seasons the animal is so constantly infested with them, and suffers so much emaciation from them, that the disease is called the rot. You have before you infected livers which were seized in our public markets this very day, and there is no difficulty in obtaining specimens of them at almost any time. A few years ago (1863), when Professor Brown was lecturing on the liability of animals to disease from the present mode of feeding them, he said that once, when he wanted some animals for dissection, and applied for them to a large butcher, he received back five or six animals, which, though in a bad state of rot, were dressed for the market; and he was told by a certain individual not far from London, that within the space of six months he had killed no less than 750 of such animals, in a state of extreme disease, and he believed they were all sent to market and sold for food. What becomes, he says, of the hundreds and thousands of rotten sheep which we see in the fields? To bury them would require whole catacombs; the real catacombs are the intestinal canals of the human body. The way in which the disease is produced in sheep is curious. Ova are passed from the gall-bladder of infected animals into the intestines, and so upon the land; finding a moist situation they are soon hatched into ciliated embryos, which swim about and become developed into cylindrical sacs of minute hydatids; these attach themselves to some mollusc, as a small snail. In wet weather the infected snails crawl upon the grass, and are eaten by the sheep, and then the hydatid speedily changes his condition and becomes a fluke. When it is found in the body of man it has, perhaps, been drunk with water or eaten with some aquatic plant, as water-cress, &c.

Our safety against these intruders is to cook the meat thoroughly.

The flesh of animals that have been excited before death, as by over-driving, or by torture, has frequently proved unwholesome. A remarkable instance of this is quoted by Liebig, in his "Letters on Chemistry," where a family of five persons were made seriously ill by the flesh of a roebuck which had been caught in a snare, and had struggled violently before death.

It is, moreover, a curious fact, that meat may be even poisonous from the nature of the food made use of by animals shortly before they are killed; and this, too, without any indication of disorder in the animals themselves. Hares which have fed upon the *Rhododendron chrysanthemum* are frequently poisonous; the same is the case

with pheasants in Pennsylvania and Philadelphia, which feed during the winter and spring on the buds of the laurel (*Calnia latifolia*); and I have known many instances of serious mischief from prairie birds which are now largely imported into this country from America, and I attribute it to the food made use of by the bird. In certain districts of North America, especially on the Alleghany mountains, the flesh of all the cattle is poisonous, and so also is the milk they yield, and the cheese which is made from it. Oysters, mussels, lobsters, and crabs have frequently caused disturbance of the human system; and the probability is that they were made unwholesome by the food which they had eaten. A singular case is recorded in the medical journals of France in 1842, where a whole family at Toulouse were poisoned by a dish of snails, the animals having been gathered from a poisonous shrub (*Coriaria myrtifolia*); and it is not at all uncommon for honey to be unwholesome, on account of its having been collected by bees from poisonous plants. The honey of Trebizond, for example, has long been notorious for its deleterious properties; it poisoned the soldiers of Xenophon during the famous retreat of the ten thousand. Pliny, too, speaks of it; and to this day its intoxicating effect is frequently witnessed. It arises, no doubt, from the plants, chiefly the *Azalea pontica*, from which the honey is gathered. Mr. Barton has given us a similar account of the poisonous quality of the honey gathered by bees from the savannahs of New Jersey, where the *calmia* and *azalea* are the principal flowering shrubs. As with the followers of Xenophon, all who eat of the honey become intoxicated to a high degree; and even when made into metheglin, it poisons all who partake of it, causing dimness of sight, giddiness, and then delirium, with sometimes a fatal termination.

(To be continued).

THE SALT DEPOSITS AT STASSFURT.*

By Messrs. BALD and MACTEAR.

(Concluded from page 66.)

In the fourth and last division, which is called the *carnallite region*, the insoluble salts are entirely gone, and even the common salt gives place in quantity to the more soluble carnallite, the average composition being:—

Carnallite	55
Common salt	25
Kieserite	16
Hydrated chloride of magnesium..	4

Carnallite, when pure, consists of $\text{KCl} + \text{MgCl}_2 + 6\text{H}_2\text{O}$, having a specific gravity of 1.618, and dissolving in about one and a half times its weight of water at 18° C.; it is crystalline, clear, and colourless, but as found in the mine it varies from pure white to a deep red colour, owing to the presence of minute quantities of peroxide of iron. This peroxide of iron, when separated from the salts, presents the appearance of a coppery bronze powder, but when viewed under the microscope it is found to consist of distinct crystals of exceedingly beautiful appearance, varying in colour from golden yellow to dark red.

The carnallite is very deliquescent, and, on exposure to a damp atmosphere, the chloride of magnesium gradually drains away, leaving the chloride of potassium behind. This probably accounts for the presence of sylvin, or pure chloride of potassium, small quantities of which are found underneath the carnallite; it is rather more abundant in the Anhalt mine, and this would further tend to prove the theory that it is the product of the decomposition of carnallite, as the chloride of magnesium is found to preponderate in the lower lying level of the Stassfurt mine as *tachydrite*.

Sylvin is variously coloured, and has a bright shining appearance, which has been not inaptly compared to mother-of-pearl. Its specific gravity is 2.025, and 34.5 parts of it dissolve in 100 of water at 18½° C.

It is occasionally found in large perfectly transparent crystals, which, according to Professor S. Magnus, of Berlin, are as transparent to heat as rock salt; and this diathermic property does not change with the temperature of the source of heat any more than rock salt does, and which has hitherto been the only substance known to possess the latter quality.

The tachydrite already mentioned is a salt having the same composition as carnallite, but in which the potassium is replaced by calcium, its formula being $\text{CaCl}_2 + 2\text{MgCl}_2 + 12\text{H}_2\text{O}$. It is very deliquescent and very soluble, 100 parts of water at 18½° C. dissolving 160.3 parts of the salt; it is the only salt which raises the temperature of the water during solution, all the others having the property of lowering it during that operation.

Besides sylvin and tachydrite, there exists also, though in such irregular quantities that it cannot be calculated upon with certainty, a salt called kianite, having the following composition:— $\text{MgSO}_4 + \text{K}_2\text{SO}_4 + \text{H}_2\text{O}$. It is evidently the product of a secondary decomposition, arising from the action, probably, during a low temperature, of sulphate of magnesium upon chloride of potassium.

We also have what is probably the most peculiar and unaccountable compound in these mines—viz., boracite, the composition of which is $6\text{MgO}, 8\text{B}_2\text{O}_3 + \text{MgCl}_2$ (sp. gr. 2.3); it is found scattered all over the deposit in nodules varying in size from the most minute up to 7 or 8 inches in diameter, and, although occurring in the most soluble salt beds, is of itself almost insoluble in water, and, in fact, is with difficulty decomposed by acids; but its greatest peculiarity is, that it always, and without exception, contains a kernel of the easily soluble carnallite or tachydrite; it does not exist in any great quantity, the annual yield being somewhere about 10 tons. A small quantity of bromine is also found in this region, existing as bromide of magnesium; caesium and rubidium can also be detected; but hitherto all attempts to prove the presence of either lithium or iodine have been without success.

The ingredients in this region do not exist as a homogeneous mass, but are deposited in distinct layers, which repeat themselves frequently, and vary in thickness from a mere line to several feet.

It is from the impure carnallite that the manufacture of muriate of potash is so largely carried on in the neighbourhood. This salt, which is coarsely ground at the mines, has an average composition of—

Chloride of potassium	16
Chloride of magnesium	20
Chloride of sodium	25
Sulphate of magnesia	10
Water	29
<hr/>	
100	

It also contains small quantities of sulphate of lime and bituminous matter, which occasion the manufacturer some considerable trouble, as in strong solutions they are light and flocculent, and, consequently, somewhat difficult to settle.

The manufacture of the muriate is entirely a question of the solubilities of the various salts, the key to which is the fact that the double salt of chloride of potassium and magnesium forms only from solutions containing exactly double the quantity of chloride of magnesium which exists in the carnallite. You will find it stated by various authorities that the "carnallite crystallises only from solutions containing a large excess of chloride of magnesium," but this has been proven by experiment to be a definite chemical quantity, viz., 4 parts of chloride of magnesium, and 1 part of chloride of potassium, or, in other words, 2 parts of chloride of magnesium, hold in solution up to a certain strength 1 part of carnallite.

* Read before the Chemical Section of the Glasgow Philosophical Society, January 18, 1868.

So that on dissolving the crude salt in water, the chloride of magnesium takes up its quantity of chloride of potassium, whilst the remainder crystallises out as muriate, mixed with common salt and a small quantity of sulphate of magnesia. The mother liquors are then further boiled down to obtain a crop of artificial carnallite, which in turn is treated in a similar manner to the raw salt, to obtain a further supply of muriate. The muriates produced vary in strength from 75 to 98 per cent.

Epsom salts are also prepared at some of the works from kieserite, whilst at others a considerable quantity of the double sulphate of magnesium and potassium, a compound containing one equivalent of each of the sulphates, combined with 6 atoms of water, is made.

This salt is largely used as a manure for the sugar beet. It is generally understood that the beet grows equally well with soda as with potash, but the cultivators prefer to use the latter, as it is nearly all recovered in the state of carbonate, and of course is greatly enhanced in value. This leads us to consider what would have been the present state of the potash trade had it not been for the opportune discovery of this deposit, previous to which our only sources of potash were the muriate and sulphate from kelp, principally wrought in Glasgow, and the north of Ireland, and the carbonate or potashes of North America. Whether the supply has regulated the demand or not it is difficult to say; but it is a fact that the produce from the two last-named sources has rather increased than decreased, whilst we have in addition the large supply obtained from the Stassfurt deposits.

This, of course, has been followed by a corresponding reduction in price—muriates of 80 per cent, which in 1863 sold at £21 10s. per ton, can now be purchased for £8 10s.

The carbonate has not fallen in the same ratio owing to the increasing employment of it in the arts and manufactures.

There is, consequently, a great prize in store for the chemist who, by his ingenuity, can discover some more direct process than that at present in use for the conversion into carbonate of the vast quantities of chloride stored up in these German mines.

To the scientific chemist and geologist this deposit presents a vast field well worthy of attentive study and research.

The generally accepted theory is that it is the product of the slow evaporation of some vast ocean, by a process similar to that which is at present going on in the Dead Sea, the waters of which are supposed to have already been evaporated down to 1300 feet from their original level. If we examine an analysis of this sea, we find that it contains $6\frac{1}{2}$ per cent of chloride of sodium, $1\frac{1}{2}$ of chloride of potassium, $2\frac{3}{4}$ of chloride of calcium, $10\frac{1}{2}$ of chloride of magnesium, and about $\frac{1}{4}$ of bromide of magnesium. The sulphates have almost entirely disappeared, and, looking at the preponderance of the more soluble salts over the chloride of sodium, we are forced to the conclusion that there must be already deposited at its bottom a vast quantity of the latter salt.

The great salt lake of North America, and some others, in the south of Russia, and in Asia, which contain almost nothing but chloride of sodium, must be regarded as fresh water lakes, which derive their saline matter from some already formed deposits of salts.

In August, 1867, the Prussian government commenced boring for salt at Sperenberg, and at the end of August, last year (1868), they had penetrated to a depth of 952 feet, principally through gypsum, when they suspended operations, to admit of more powerful instruments and machinery being made. These being now supplied, the work is again going on. There is no doubt that they will reach the salt strata, and we await the result with considerable interest, to see if the potash salts exist there also.

There are others besides scientific men, to whom these mines are a source of considerable interest. To the political economist they mean an almost inexhaustible supply of the "savour of the earth," employment to the

people, trade to the country, and pounds, shillings, and pence to the merchant and manufacturer.

To the visitor, be he scientific or non-scientific, a visit to the mines will amply repay him for his trouble.

The appearance of the workings in the kali salt portion of the mine is no less beautiful than wonderful, and is so entirely unlike what we see in mines in this country that we are entirely at a loss for anything to which we can compare them, and it is utterly impossible for any description to prepare the visitor for the novel sight which meets his eye when he enters these workings for the first time.

All have heard of, and many have witnessed, the wonderful grandeur of the Mammoth and other caves of North America, with their unfathomable subterranean rivers, where size and form, together with the light and shade produced by the flickering torches of the guides, are what excites the admiration of the traveller.

At Stassfurt we have neither the rivers nor the vast size, but we have space, which, in the bowels of the earth, seems great; we have beautiful form in the sparkling irregular angles formed by the pick and in the cavities left by the blast, to enhance which there is the magic charm of colour—colours of nearly every tint in the rainbow, passing from a deep purple through crimson, bright red, orange, and yellow, to snowy white, all in regular layers, but varying in size and arrangement, and from the angle of the dip each layer forming an almost perfect arch. The effect is further heightened by the nodules of boracite, which have the appearance (as graphically described by a Glasgow gentleman who is well acquainted with the mine) of having been shot at random from a park of artillery, so irregularly are they scattered, and so firmly are they imbedded in what meanwhile seems to us an altogether foreign place for them.

On the occasion of our visit, after having been conducted through such a gallery as we have attempted to describe, we left the main working, and after going a few yards through a narrower passage we found ourselves in a small chamber about 20 feet square—the preliminary opening for a new working. Underneath what is now the roof of this cavern there had been a lodgment of water, which had completely dissolved all the more soluble salts, and left the common salt and chloride of potassium in magnificent crystals of absolute purity; this formed a dome-shaped roof, which, sparkling and glistening in the light of our lamps, rivalled in beauty anything we had ever imagined of the celebrated Valley of Diamonds.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 4, 1869.

Dr. WARREN DE LA RUE, F.R.S., President, in the chair.

AFTER the usual formal business, the PRESIDENT announced that Dr. Wallace, of Glasgow, who had promised a lecture "*On the Chemistry of Sugar Refining*," had been prevented by illness from attending, but that he had forwarded his diagrams and tables, together with the MS. of his lecture, and that the latter would now be read by the secretary.

Mr. VERNON HARCOURT accordingly proceeded to read the discourse, of which the following is an abstract:—

After a few introductory remarks upon the complexity of the science of chemistry, upon the importance of the technological branches of it to many Fellows of the Society, and upon the encouragement afforded to the study of those branches by the Society, the author draws attention to the statistics of the sugar trade in this

country. From the Board of Trade returns for 1868, it appears that 594,656 tons of sugar of all sorts were imported in that year. The duty on this quantity amounted to nearly five and a half millions, and the total money value, including duty, to £21,000,000. At least 400,000 tons were refined in this country. Foreign countries, particularly France, offer very formidable opposition to the English refiners, no less than 34,039 tons in 1868, and 42,047 tons in 1867, of refined sugar having been imported. The author has shown, in a previous discourse*, the unfair terms on which our refiners have to deal with foreign countries. He attributes the present stagnation of the sugar refining trade in London mainly to this unfair competition, but also to the extraordinary development of the industry within the last few years in Greenock and Glasgow. In 1857 the quantity of sugar refined in the Clyde was 38,336 tons, while in 1867 the quantity had risen to 178,013 tons. Last year it amounted to only 171,643 tons, but even this quantity is two-fifths of the whole amount of sugar refined in the United Kingdom. The author believes that the London refiners have been somewhat slow in adopting the most recent improvements introduced in the provincial refineries, and they have been unwilling to give up the making of loaf sugar, which is not now profitable. They work, moreover, under considerable disadvantages in various respects. The refining process here described is that adopted at Greenock for crushed or soft sugar. Its chief peculiarity is that no syrup is produced; all the sugar leaves the refinery in the solid form, and the loss of all kinds only amounts to about 5 per cent.

Sugar Refining.—A proper selection of the raw sugar is a very important point in the refining process. In the Greenock system the raw sugar employed must not contain more than 3 or 4 per cent of uncrystallisable sugar; but where syrup is produced this is of less importance, and concrete and low sugars may be used. Mixtures are often judicious, but on the Greenock system a large proportion of beet sugar is avoided. Several points must be considered in purchasing raw sugar for refining—the proportions of cane and fruit sugar, the amount of extractive, as determining the quantity of animal charcoal required and its deterioration in the process, and the amount of insoluble matter, which, when excessive, is troublesome to wash, must all be taken into account.

The author next gives a table of the composition of twenty samples of raw sugar of different kinds, but remarks that they must not be taken as typical of the various kinds indicated, as they vary extremely in composition.

The French mode of determining the value of a sample of sugar is, upon the whole, a very fair and accurate one. Each percentage of fruit sugar is assumed to prevent the crystallisation of 1 per cent, and each percentage of soluble salts of 5 per cent of cane sugar; thus a sample of Paraiba sugar contained 84.9 of cane sugar, 6 of fruit sugar, and 1.7 of soluble salts; this sample would accordingly yield 70.4 per cent of cane sugar.

First Operation—Solution.—This, which is technically known as “blowing up,” from the fact that open steam was formerly used in it, is effected on the highest floor but one of the building. The blow-ups are cast-iron pans, 4 or 5 feet high and 6 to 10 feet in diameter. The steam is admitted by a heating worm below a false bottom; above and below this false bottom revolving arms keep the liquor in constant motion. Water is introduced into the blow-up, the steam turned on, and the sugar thrown in as quickly as possible from the floor above. In half an hour the filling should be completed, when the liquor should have a specific gravity of about 1.225 (28° Baumé) and a temperature of 180° F. It consists of about two parts of raw sugar to one of water, and a pan of 10 feet diameter will dissolve about 7 or 8 tons of raw sugar. A small amount of flocculent and insoluble matter is

removed as scum during the operation. This is the simple process pursued in most of the Clyde refineries; but in others various methods of treatment are adopted to facilitate the purification. Milk of lime is sometimes added to neutralise the small trace of acidity in the raw sugar, and the author thinks this useful, provided that an excess is avoided. The use of blood or albumen was formerly common, but as they render the syrups impure, they are now generally dispensed with. Other reagents have also been used, such as sulphate or phosphate of aluminium or lime, or soluble tricalcic phosphate and lime, but there is great danger of the workmen adding too much of one or another of them, and their use does not appear to be necessary. The dust of animal charcoal has a good effect when quite new, but it cannot be used more than once.

The next operation consists in passing the solution through twilled cotton filter bags in coarse canvas sheaths. These bags are fastened, to the number of 200 or so, to the bottom of a shallow tank, into which the liquor from the blow-up pan is passed. The sides are kept hot by steam.

Decolourising the Syrup.—Animal charcoal has been found by practical experiments to be the most suitable for sugar refining. Many kinds have been tried, some of them much more energetic than it as decolourising agents, but none possess its peculiar combination of valuable qualities. An artificial mixture of clay and some form of carbon has been said to rival animal charcoal, but the author has heard nothing of it lately. Seaweed charcoal approaches most nearly to that of bones, but wants some necessary characters. Sulphurous acid has been tried repeatedly, but it never removes more than three-fourths of the colouring matter, and its liability to change into sulphuric acid renders its use dangerous; for though sulphurous acid does not alter cane sugar, the latter acid does, and even if this is neutralised by lime, the resulting sulphate of lime is injurious to the charcoal, which must subsequently be used. The author has made no experiments on the bleaching action of ozone, but fears that its oxidising action on the sugar would prove troublesome. The carbonation process used on the Continent is excellent for the juice of the beet, but would not be advantageous in the refining of raw cane sugar. It might be found useful in certain cases, as for instance in purifying the washings of animal charcoal. The author considers that it is an excellent arrangement to have a smaller refinery connected with the larger one for the separate treatment of impure products. The use of alcohol with a minute portion of hydrochloric or acetic acid, to remove earthy salts before filtration, is next discussed; it has been tried on the large scale in Belgium, but discontinued. Theoretically, it is most advantageous, but its expense would be fatal to its use here, except, perhaps, with duty-free spirit. A moderate-sized sugar house would require about 10,000 gallons of almost absolute alcohol, and this must be re-distilled every day. The process has long been used most successfully for testing raw sugars.

Filtration through Charcoal.—The clear liquor is now run into iron tanks filled with animal charcoal, allowed to “settle” for several hours, and drawn off colourless below. At the same time more of the dark liquor is run in at the top, so as to keep the cistern full. When the sugar solution begins to come away yellow, the sugar solution is replaced by the syrup from a previous refine; the whole of the sugar is then washed out with hot water, and the charcoal, after draining, is taken to the kiln to be re-burned. The author gives many interesting details as to the size of the cisterns, the size, or “grist” of the charcoal, &c., which our limits compel us to omit. He refers, for a full discussion of the qualities of animal charcoal, to a lecture delivered in Glasgow during last year, and duly recorded in our pages*. In the present discourse

* CHEMICAL NEWS, Dec. 18, 1868.

*CHEMICAL NEWS, May 22nd, 1868.

he confines himself to the consideration of certain points.

Three analyses of new animal charcoal are first given, the samples containing respectively 9.71, 7.64, and 10.37 of nitrogenous charcoal, in the dry substance. As sold it generally contains about 10 per cent of water. The so-called carbon of animal charcoal contains a notable proportion of nitrogen, and a little hydrogen. The nitrogen is generally about 1-10th of the total carbonaceous matter, but is sometimes considerably more. Old charcoal contains less nitrogen, and the proportion constantly diminishes. The nitrogen appears to be an essential constituent of animal charcoal. Red-hot animal charcoal, quenched with water, evolves ammonia, and the practice ought, therefore, to be avoided. New charcoal always contains traces of ammonia, as well as of sulphides of ammonium and calcium. In a particular case, .011 per cent of ammonia was found; and in another, a sample of charcoal evolved .08 per cent of hydric sulphide when treated with an acid. Both new and old charcoal retains appreciable quantities of gases, which escape when the tanks are filled with liquor, and sometimes explode when a light is brought to the top of the cistern.

Old charcoal should always contain more carbon than new, on account of the carbonisation of the impurities separated from the sugar. If the carbon does not increase with the age of the charcoal, it shows either that air has been admitted during the re-burning or that the re-burning has been effected at too high a temperature. The increase of carbon in the charcoal is an evil, and should be diminished as far as possible by thorough washing before it is re-burnt. The extensive washing has another advantage, for it tends to remove the mineral salts, particularly calcic sulphate, which had been taken up from the sugar. As long as the sugar liquor is strong, calcic sulphate is absorbed and retained by animal charcoal; but when the washings begin, the salt comes away in solution.

Another cause of the deterioration of charcoal is the constant shrinking of its volume, and its consequent diminution in porosity. A ton of new charcoal usually occupies about 50 cubic feet, but this diminishes to 40, and even in one case to 28 cubic feet. This appears to be due to a partial fusion of the calcic phosphate, and is not accompanied by any great alteration of specific gravity. All these considerations point to the necessity of renewing the charcoal very frequently. With regard to the quantity of charcoal required, much depends on the nature of the sugar. For a ton of sugar, 25 cwts. of good charcoal is amply sufficient; and for fine sugar an equal weight is enough. The less used the better; and it is a mistake to suppose that a large quantity of bad or exhausted charcoal will serve the same purpose as a smaller amount of good. The work will not be so well done, and the waste of sugar will be greater. As illustrations of the composition of old charcoal, the author gives his analyses of nine samples, which differ very remarkably in composition. The percentage of nitrogenous carbon varies from 2.56 to 19.64.

The calcic carbonate in charcoal is useful in neutralising the minute quantity of acid present in all sugars and also the acids always formed during the washing of the charcoal. When very soft water is used, the quantity of calcic carbonate diminishes or even disappears. On the other hand, with very hard waters, or when lime is added in the process, as in the beet factories of the Continent, it often increases to an inconvenient extent. This is best remedied by Mr. Beanes's process, which consists in impregnating the burnt charcoal with perfectly dry hydrochloric gas, exposing it to the air until the excess escapes, washing thoroughly with water and burning. Beanes's process, and others of a similar nature, may be applied with advantage to new charcoal, to bring it at once into efficient working condition.

The oxidising power of the charcoal is attended with a grave inconvenience in sugar refining. When the char-

cisterns are to be washed off, hot water is introduced, while the heavier syrup descends, but the liquids commingle to some extent, and a weak solution of sugar is formed, which is exceedingly liable to undergo the lactic fermentation. The ferment appears to be generated by the action of the dissolved oxygen of the water under the influence of the charcoal upon the vegetable albumen removed by the charcoal from the sugar. It is a common, but very mistaken custom to use the char washings in dissolving fresh sugar.

With respect to the temperature required in the refining process, the liquor in the blow-up pans should be run off at 180° F.; the char cisterns should be at 155° F., and never below 150°; and the water used for washing should be absolutely boiling. The minimum quantity of water required for refining 100 tons of sugar is about 215 tons, or nearly 50,000 gallons.

Revivifying of the Charcoal.—The re-burning of the charcoal is effected in kilns, which consist of upright cast-iron pipes arranged in rows. The wet charcoal is introduced at the top, and sinks down as from time to time the portions which are sufficiently burned are drawn off at the bottom. The flame plays directly upon the pipes, and those which are nearest to it receive the most heat, and their contents must be exposed to it for a proportionately less time—five hours being sufficient for the nearest row, whereas ten hours may be required for the farthest. It is a great mistake not to dry the charcoal, either partially or completely, before introducing it into the kilns, as the wet mass hinders the escape of gases from the lower portions, and much heat is wasted in evaporation.

Evaporation of the Liquor.—This is effected, as is well known, in the vacuum pans. The improvements introduced of late years into the vacuum pans consist in increasing the extent of heating surface and the quantity of water injected into the condenser, and in enlarging the neck of the pan to 18 inches, or even more. A good-sized pan is 10 or 12 feet in diameter, and holds about 20 tons of sugar and syrup. The boiling down occupies two or three hours, the vacuum averages about 28 inches, and the temperature is usually about 120° F. at the beginning, and about 130° F. at the end of the process. The solution is introduced a little at a time, and the first portion is boiled until a "grain," consisting of almost microscopic crystals of sugar, forms, and these increase in size as the boiling proceeds, until at the finish they are as large as may be desired. When large, distinct crystals are required, the liquid is boiled more slowly and at a higher temperature, and when the pan is full, only one-half of the contents is drawn off. This is repeated several times, the crystals becoming larger every time. The author points out that it is not necessary to increase the temperature, but only to diminish the rapidity of the boiling, in order to obtain fine crystals. The high temperature usually employed for the production of large crystals only serves to increase the quantity of uncrystallisable sugar formed, and to darken the colour of the syrup.

In boiling down the syrup obtained from the drainage of the first crop of crystals, less care is required, a small grain being preferred as carrying more syrup. Three qualities of sugar are usually prepared by this process, viz., whites, mediums, and yellows. For the yellows, the syrup is evaporated as a "jelly," that is, the formation of grain is entirely avoided, and the jelly is left for several days to crystallise. The crystals of all three kinds are separated from the syrup by a centrifugal machine, the periphery of which travels something like 100 miles an hour. From three to twenty minutes are occupied in the drainage, according to the quality of the sugar. The whitest crystals are sometimes washed with a little cold water.

The PRESIDENT pointed out that other charcoals, not containing phosphate of lime, gradually contracted, and got hard when exposed to long-continued, although not necessarily very excessive, heat. It was well known that

coke burnt at a low temperature became extremely dense. He knew from his own experience that light porous charcoal or coke would, if the heat were continued for a very long time, gradually contract. Gold, precipitated in a porous state by a proto-salt of iron, gradually contracted when heated far below the melting point of the metal. Referring to some experiments of his own made many years ago, the President stated his impression that lime really converted sugar into an uncrystallisable state, and that the addition of an acid did not then restore it. It appeared that animal charcoal still held its ground as a decolourising agent, in spite of all the new plans proposed. Its remarkable absorbent power reminded him of that which he had observed in sulphide of lead during his investigations on carminic acid; it entirely removed all the colouring matter, and led to the misapprehension that the cochineal was being changed in its nature.

Dr. HUGO MULLER remarked that lead could not be used with advantage in the treatment of liquids like sugar. Dr. Scheibler had recently found that several liquids of that kind had a very extraordinary power of dissolving and retaining sulphide of lead, and that this lead could not afterwards be separated from them.

Mr. PEARSON deplored the unavoidable absence of Dr. Wallace, as there were many points upon which further information would have been desirable. He commented upon some points connected with the statistics of the trade, and made a few observations on the marvellous powers of animal charcoal. The remarks of Dr. Wallace on the washing out of the products were very important, but, in the south, a limit is rapidly attained in the washing, for even when the New River water was used, it was soon found to be running off purer than when it was put on, from the abstraction of the earthly matters by the charcoal.

Dr. HUGO MULLER stated, in reply to a question put by the President, that the decolourising power of animal charcoal was reduced, though not destroyed, when the phosphates were dissolved out of it by hydrochloric acid.

Mr. WILLIAMS confirmed this statement. The pure charcoal would do more than the common charcoal, bulk for bulk, but there was no comparison in the percentage action of the carbon in the two cases.

Dr. VOELCKER requested permission to ask Mr. Beanes, who was present, the result of his experiments on the decolourisation of sugar by ozone.

Mr. BEANES feared that the ozone process was not yet sufficiently advanced to enable him to speak with certainty about it. His experience so far had taught him that ozonised air, passed through a coloured syrup for three hours, produced as much decolourising effect as contact with animal charcoal for twenty-four hours. His experiments had been unavoidably discontinued for a time, but he hoped shortly to return to them.

Professor WILLIAMSON hoped that some gentleman present might be able to give some information upon one point, which had been but slightly touched by Dr. Wallace, and which yet was of great importance. He alluded to the relation believed to subsist between the soluble salts of the raw sugar and the crystallisable sugar prevented by them from crystallising.

The PRESIDENT asked Dr. Williamson whether he supposed that these soluble salts merely retained the sugar, or whether they changed it in any way.

Professor WILLIAMSON said that his own information upon the subject was mainly derived from experiments made by another gentleman in his laboratory, and he did not feel justified in going into particulars of them. Some salts appeared to possess the property of retaining sugar in solution, while others had an opposite property, and actually accelerated its crystallisation.

Dr. VOELCKER remarked that beet-root sugar often contained a good deal of common salt. Now, as beet-root contained no fruit sugar, and yet salt was present, it would seem to point out that chloride of sodium had not

the effect of changing the nature of the sugar, but simply of preventing in some measure its crystallisation. That it had the latter power was well known, and sugar refiners dreaded its presence more than that of almost any other salt.

The meeting then adjourned to the 18th inst.

GLASGOW PHILOSOPHICAL SOCIETY. (CHEMICAL SECTION).

A MEETING was held in the Society's rooms, Andersonian Buildings, on Monday, the 1st inst, at eight o'clock in the evening, James Couper, Esq., St. Rollox Chemical Works, in the chair. One new member was admitted, and one candidate proposed.

A paper was read by P. M. MOIR, Esq., "On the Preservation of Timber," which we shall endeavour to give as fully as possible in our next.

FOREIGN SCIENCE.

PARIS, FEB. 10, 1869.

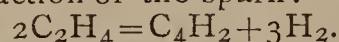
Patent for Murexide.—Topaz Deposit.—Electro-capillary Actions.—Proximate Constituents of Cotton Fibre.—Action of the Electric Spark on Marsh Gas.—Academy of Sciences.—The Solution of Sulphur.—Photographing on Enamel.—Hydrogen and Palladium.—Physiological Action of Conia, Ethylconia, and Iodide of Diethylconia.

A PATENT has been granted to MM. Kessler and Luxer for the preparation of uric acid, and the products employed in dyeing. Murexide is prepared according to two methods by the authors. In the first process, to a mixture of equal parts of commercial nitric acid and water, small portions of uric acid are added from time to time. At each addition, an action is manifest, and when too much uric acid is presented at once the temperature rises, and binoxide of nitrogen is disengaged. However, towards the finish, there is no fear of the liquid becoming too hot; on the contrary, it becomes necessary to aid the reaction by gentle heating, in order to dissolve all the uric acid possible. The more or less brown liquid thus obtained is filtered, and mixed in the cold with about an equal weight of ammonia. A red colouration and turbidity are caused; by the heat of a water bath abundant crystals of murexide are deposited, and the mother liquor, by evaporation, yields a reddish brown dry mass. In the second process the authors act on solutions of alloxan with ammonia salts of reducing acids, giving the preference to formiate of ammonia, the operation succeeds, likewise, with oxalate, but not so well with acetate. It is better to use rather concentrated solutions of the two bodies and to employ heat. The ammoniacal salt is added so long as the liquid separated by cooling from murexide, and thereby decolourised, becomes coloured by the addition of a trace of the ammoniacal salt.

In a very difficultly accessible cave in the mountain of Galenstock, which separates the canton of Berne from that of Uri, a very rich deposit of topaz has been recently found, valued at more than 100,000 francs.

M. Becquerel in his sixth memoir "On Electro-Capillary Actions" describes the processes which he employed to obtain a great number of hydrated oxides in the crystalline state. In a vessel containing a solution of nitrate of copper, a smaller vessel, one side of which was composed of parchment paper, was placed, containing aluminate of potash. Nitrate of potash was produced but in the place of aluminate of copper; in the porous vessel crystals of hydrated alumina presented themselves, and on the outside crystals of hydrated oxide of copper formed. By replacing the aluminate of potash by silicates, M. Becquerel obtained hydrated silica sufficiently hard to scratch glass.

M. Berthelot has examined the action of the electric spark on marsh gas. When a succession of powerful sparks is made to traverse pure marsh gas, carbon is deposited and the volume of gas augments considerably. Operating with 100 c.c., this volume becomes 127 c.c. at the end of two minutes, 154 c.c. at the end of ten minutes, and so on; but some hours are required for the complete destruction of the marsh gas. That no marsh gas remains at the end of the experiment may be demonstrated, after removing the acetylene and the traces of condensed vapours which are present mixed with hydrogen. According to received theories, the volume of marsh gas should become double, since it is resolved into hydrogen and carbon:— $C_2H_4 = C_2 + 2H_2$. The experiment does not agree with these theories, 100 volumes of marsh gas furnishing only 181 volumes in two concordant determinations. Acetylene constitutes 13.5 to 14 per cent of the products; the half of the marsh gas is transformed into acetylene by the action of the spark:—



At the commencement of the experiment the acetylene formed corresponds to an almost complete transformation of the marsh gas, but the proportion of acetylene formed from the marsh gas is smaller in proportion to the amount of acetylene present. Therefore, by arresting the experiment for a few minutes, and absorbing the acetylene, it should be possible to push the action further. M. Berthelot has been able in this way to form 39 volumes of acetylene from 100 volumes of marsh gas; these figures show that four-fifths of the marsh gas was converted into acetylene. The conversion of marsh gas into acetylene does not explain directly why the volume of gas is not doubled under the influence of the spark. In fact, the formation of acetylene, as well as carbon, corresponds to a double volume; but acetylene under the influence of heat passes into condensed hydro-carbons. Thus, it is easy to detect the presence of triacetylene or benzol vapour in the gaseous products of the reaction, by agitating with fuming nitric acid. By reason of these condensations, a part of the hydrogen remains combined in the heavy vapours or fixed compounds, thus diminishing the volume of free hydrogen. Half of the marsh gas is converted into acetylene, 3-8ths into condensed hydro-carbons, and 1-8th simply into carbon and hydrogen. These results point to a similarity in the action of the spark and that of heat. The prolonged action of a dull red heat ends in nearly the whole of the acetylene being condensed, even in the presence of a large excess of hydrogen. The electric spark, however, only acts on the acetylene when pure, or mixed with less than six times its volume of hydrogen.

At the meeting of the Academy on the 11th of January, M. Lefort contributed a note on the solution and estimation of sulphur by means of aqua regia, and M. Duchemin a note on photographing on enamel.

The enamel used for painting and photography is composed principally of silica, oxide of tin, and oxide of lead; the mixture is melted on copper, gold, or platinum. Besides the high price, the enamel produced in this way is defective in not possessing a flat surface, in consequence of which the photographer is obliged to transfer the image on to the enamel. Crown glass covered with a fusible enamel, having arsenic for the base, can replace very economically the surfaces obtained by the more expensive method. M. Duchemin gives the processes most suitable for this branch of photography.

M. Lefort describes the action of aqua regia on sulphur to be, firstly, the formation of chloride of sulphur; secondly, the destruction of this compound by nitric acid or its derivatives; and consequently the regeneration of the chlorine, the evolution of nitrous vapours, and the formation of sulphuric acid. In proportion to the amount of nitric acid present, is the solution of the sulphur quickly arrived at. The most convenient mixture of hydrochloric and nitric acids for dissolving sulphur, is made with 1 volume of the former and 3 of the latter.

At the meeting on the 18th of January, a memoir was communicated by Professor Graham, on hydrogen in its relations with palladium, a memoir with which your readers are already acquainted. M. Wurtz, in commenting upon the results set forth in this memoir, remarked that he had formerly attempted to prepare a hydride of palladium by the process which enabled him to prepare a definite combination of hydrogen and copper, viz., the reduction of sulphate of copper by hypophosphorous acid. When an excess of a solution of this acid is added to the solution of a palladium salt the liquid becomes turbid, and in a few minutes a finely divided brown precipitate is deposited. Nearly immediately, and even at 0°, an evolution of hydrogen is manifest, and if heated the evolution of gas becomes very brisk. As soon as the hydrogen ceases to come off the liquid begins to clear, and the precipitate now appears black and flocculent—this precipitate is palladium. From these facts it would seem that the pulverulent and amorphous palladium precipitated by hypophosphorous acid is incapable of retaining hydrogen.

The only other memoir we have to notice from this meeting is one by MM. Pélassard, Jolyet, and A. Cahours, on the physiological action of ethylconia and the iodide of diethylconia compared with that of conia. Ethylconia and the iodide of diethylconia lead, like conia, to a rapid poisoning of the pneumogastric nerves, differing at the same time in possessing a less energetic and more passing action on the voluntary nerves. In equal conditions, conia is more poisonous than ethylconia, which is again more poisonous than the iodide of diethylconia. Thus, a relatively longer time is required for ethylconia to destroy nervous excitability than for conia, and with the iodide of diethylconia, the movements of the nerves are never more than weakened. It is a fact worthy of remark that the introduction of the radical ethyl with the conia abolishes the period of convulsions which precedes the paralysis in poisoning by this alkaloid: the fact is particularly seen in poisoning by iodide of diethylconia, where the animal falls incapable of making voluntary movements, without this paralysis being preceded by the slightest convulsions.

Thus the introduction of ethyl with conia produces similar results to the introduction of this radical into strychnia.

OBITUARY.

BARON VON REICHENBACH.—This philosopher died recently at Leipzig, aged 81. His researches on the products of the destructive distillation of coal and wood, and his great work on meteorites, are well known to our readers. His investigations on the supposed new *odylic* force, also deserve notice as a remarkable instance of philosophic enquiry applied to subjects scarcely yet within the grasp of scientific reasoning.

CORRESPONDENCE.

CHEMICAL AFFINITY AND ELECTRICITY.

To the Editor of the Chemical News.

SIR,—A course of experiments on electric decomposition has led me to a line of thought which appears to promise a great simplification of chemical and electric theory.

We are accustomed to speak of bodies as being formed and held together by the strength of chemical affinity and decomposed by virtue of a stronger; thus silver dissolves in nitric acid because of their affinity, while copper displaces the silver, and zinc in turn the copper, by their relatively greater affinities for the acid.

We also suppose that the galvanic current effects decomposition by means of its greater force, attacking the

molecule and overcoming the affinity which holds it together; in fact, by a conflict in which the strongest force conquers.

Is not the true theory exactly the reverse in both cases? In the example noted, the silver in dissolving gives out heat; the copper in precipitating does the same, and the zinc repeats the process, the three heats together being equal to that which the zinc alone would give in dissolving. Now surely the loss of heat cannot be an indication of increased forces.

Among the old subdivisions of affinity, predisposing affinity played a great part in chemical reactions. Now, as heat has a strong tendency to radiate away into space, is it not highly probable that this is the predisposing cause of chemical reactions—that bodies will combine together, or alter their forms of combination whenever the latent heat essential to the new form is less than that of the old, and the conditions permit the free motion of the atoms and the setting free of heat?

In this light the amount of heat set free in any action is the measure of the so-called affinity at work; this is already well-known as a fact, but hitherto it has been treated as a mere incidental consequence of the reaction. Is it not rather the sole effective cause?

This view gives at once a clear explanation of the decomposing action of the galvanic current. It is well known that different substances present different resistances, and therefore require varying electro-motive force in the current, and the reason is, not that the force of affinity has to be subdued, but that to enable the elements of a compound to resume their separate forms, we must re-charge their atoms with the amount of force they lost in the act of combining. This is done by the electric current, whenever each molecule, the pulsations of which constitute the current, is charged to the necessary degree, and unless the electro-motive force is raised to that degree, the molecules cannot move or the current pass. The same effect is produced by heat, only when its temperature is raised to the corresponding degree, when the molecules become charged with the force necessary to their separate existence; then, if other circumstances are such as to permit the component elements to be removed from each other and thus prevent immediate recombination, the force becomes latent and decomposition is effected.

Thus chemical combination is due to the loss or escape of combined or latent force. Chemical decomposition is due to force becoming latent or attached to the atoms.

This view of force brings into relation many things at present looked upon as exceptional, and furnishes a general law for all chemical phenomena; thus it shows why reactions always occur when an insoluble substance, or a less soluble one can be produced, because that implies less latent heat, and it explains the difficulties of disassociation of vapours, because that must occur when the temperature charges the atoms with the force necessary to their separate existence, though if not separated, they reunite as soon as the temperature falls below that point.—I am, &c.,

JOHN T. SPRAGUE.

THE NEW PETROLEUM ACT.

To the Editor of the Chemical News.

SIR,—In answer to many inquiries, as well as to the question by "A Wholesale Firm," in your last issue, allow me to state that benzol, as a mineral product, unquestionably comes under the act. Ether, as a vegetable product, does not; hence, doubtless, the deduction will be drawn that dealers in ether should be allowed to sell the less dangerous benzol without restriction—that, in fact, pharmacists should have been exempted from the operation of the new law. But it is the public, not chemists, who are to be educated to recognise the inflammable properties of these lamp oils and spirits, and as the public frequently, except in large towns, purchase such materials of phar-

macists, exemption of the latter would have been most mischievous.

Wholesale and retail chemists and druggists will find that the act itself does not cause an unreasonable amount of trouble in requiring them to carry out its praiseworthy object of further protecting life and property from fire. Local licensing bodies, however, who are just now making regulations as to the storage of petroleum by oilmen, may unconsciously cause a vast deal of annoyance to those pharmacists who do not sell burning oils in any form, and only benzol and petroleum in little bottles under the name of glove-cleaning liquids. It is for such gentlemen, or, perhaps, the Pharmaceutical Society in their name, once for all to memorialise the Home Secretary with a view to the adoption of some rule whereby local conditions of licence, which are unnecessarily irksome to pharmacists, may be modified in the case of persons not dealing in lamp oils. Clause 6 of the Petroleum Act of 1862, which is read as one with that of 1868, specially provides this course in anticipation of difficulties such as those above mentioned.—I am, &c.,

THE PROFESSOR OF PRACTICAL CHEMISTRY TO
THE PHARMACEUTICAL SOCIETY, AND LONDON
ANALYST TO THE FIRE OFFICES.

MISCELLANEOUS.

How to Make Claret.—At the meeting of the Polytechnic Association of the American Institute on the 7th of January, during a discussion on the adulteration of wines, Dr. Van der Weyde is reported by the *American Artisan* to have described a mode of making claret, viz., by allowing water to soak through shavings, and adding thereto a certain proportion of logwood and tartaric acid. This produced a wine hardly to be distinguished in flavour and colour from claret.

Coloured Socks again!—The following advertisement appeared in Tuesday's *Times*:—"Sock and Shirt Poisoning.—A committee having been formed for the purpose of fully investigating the above subject, all persons who have suffered from wearing coloured socks or other coloured surface clothing are requested to send statements of their cases, with a portion of the garments from wearing which they have so suffered, to the honorary secretary, Emil Pohl, Esq., No. 15, Fenchurch-street, London, E.C. Medical gentlemen will also greatly oblige the committee by the particulars of cases that have come under their observation, with any comment they may have to offer."

The Heaton Steel and Iron Process.—We insert the following abridgment of an article from *Engineering*, but without endorsing the opinions there expressed. A long article on the subject is in preparation and will appear in our pages next week:—

"Careful and unquestionable analyses lately made by Professor Dr. W. A. Miller, showed that the initial product of the so-called 'Heaton steel process' was neither iron nor steel in any form immediately applicable to use. The crude product, by repeated heating and hammering, or rolling, could be brought to the stage of an iron of inferior quality, but probably at a cost greater than that necessary for making equally good iron from puddled bar, which of itself is cheaper than the crude product of the nitrate process. The 'Heaton process' never produced an ounce of steel, nor anything resembling it, but merely an inferior iron from which an inferior steel could be afterwards made by the usual process of melting along with carbonising substances. In saying this it should also be said that, hoping against hope, it had been widely, if not generally, wished that Mr. Heaton's representations were true, and that all his expectations would be realised. It is easy for those having no practical knowledge of a subject to place their faith in chance and the possibilities

of discovery, but every inch of ground entered upon anew at 'Langley Mill' had been explored long ago, and without profit. The main gist of the paper, the first few lines of which have been quoted, is to prove that, notwithstanding an enormous amount of puffing in divers papers and periodicals, to make the process known and to set forth its immense value, it has proved a signal failure also in respect of obtaining subscribers to form a limited liability company. To some of the few shareholders in this concern has been issued a printed 'cost-sheet,' wherein it is certified that the actual results of making steel by the Heaton process, at Langley Mill, is something between £5 and £6 per ton; while every steel maker knows that this is about the cost of mere conversion of wrought-iron into cast-steel, saying nothing of the cost of the iron itself, which must be of superior quality. The furnace in which Mr. Heaton professes to melt steel at a cost for coal (not coke) of 5s. per ton was never built. It is, presumably, the wonderful furnace patented by him, which furnace could not, by any human possibility, melt steel at all, and still less, were that possible, could it melt wrought-iron, which Mr. Heaton must employ in making steel according to the common process. Were his presumed impracticable furnace capable of melting wrought-iron, were it in fact available for steel making, it would not even then have any relation whatever to the so called Heaton process of converting pig-iron, but would constitute a distinct invention, which the Sheffield steelmasters would be glad to adopt, if they could feel perfectly assured of the truth of Mr. Heaton's statements, as to the melting of a ton of steel by some 17 cwts. of coal at a cost of 5s. It appears more and more, as might be almost *à priori*, stated by men thoroughly conversant with the metallurgical processes, approved of by a long experience, that the nitrate-steel process could never realise what has been too imprudently asserted as to its merits and technical value."

NOTES AND QUERIES.

Dissociation.—In studying the phenomena of dissociation, Berthelot has discovered that sulphide of carbon is decomposed into sulphur and carbon at the same temperature at which S and C unite to form sulphide of carbon.—*Engineer*.

Utilisation of Waste Heat.—Can any of your courteous readers inform me whether the waste heat from coke ovens has ever been utilised (under patent) in the alkali manufacture, either for the raising of steam, evaporation, or in decomposing furnaces?—W. F. K. Stock.

Soap-Tablet Stamping Machine.—A subscriber would be glad to hear of the proper parties for supplying soap-tablet stamping machines and dies. He has read articles on the subject in Muspratt, and also in Richardson and Watts; but it is probable that there is something better in use than any machine described there. Who would be the likeliest engineer to supply what is required?

Action of Cyanogen on Hydrochloric Acid.—Messrs. R. Schmidt and Glutz have recently made a very beautiful experiment. When a current of gaseous cyanogen is passed into hydrochloric acid, as concentrated as possible, no colouration is observed, but after twelve hours crystals of oxamide make their appearance, and the supernatant liquid contains oxalate of ammonia. With iodhydric acid the result is the same; oxamide is likewise formed, but iodine is displaced, and the liquid is found to contain hydrocyanic acid and iodide of ammonium.—*Engineer*.

Spontaneous Combustion of Silk.—M. J. Persoz has read a paper "On the Spontaneous Combustion of Silk." It is well known that silk, which, in the operations of bleaching, cleansing, &c., loses considerably in weight, can be made to fill up again, or can be charged (especially black silk) so that the material will actually gain 100 to 300 per cent in weight by this treatment. The substances usually employed for this purpose are astringents, such as catechu, gall nuts, and certain salts, especially protosulphate of iron. A charged silk of this description was found to contain 22 per cent of water, and from 11.0 to 11.5 per cent of impurities. When dried at 110° to 115° C., it took fire spontaneously as soon as air got free access to it. This effect appears to be owing to the rapid absorption of moisture, during which oxidation occurs as rapidly.

The New Petroleum Act.—According to the definition as read in the act there can be no doubt whatever that benzol is among the substances alluded to, *i.e.*, intended to be within the category of those substances which are recited in the act; I have seen that a dealer in gloves has made application for a license to be allowed to keep on his premises in Regent Street 20 gallons of benzol.—Dr. A. A.

The New Petroleum Act.—In reference to the enquiry of your correspondents, "A Wholesale Firm," whether benzol comes under the operation of this act, I beg to say that the definition in clause 3 of "Petroleum," that it will be illegal to keep (otherwise than for private use) without a license, or to sell, unless the vessel containing such material have attached to it a precautionary label, includes *any oil made from coal, schist, shale, peat, or other bituminous substance and any product of them giving off an inflammable vapour at a temperature of less than 100° F.* Unless the naphtha of gas-tar cannot be regarded as an "oil," it would appear to be comprised in this definition as being a product of coal, and as giving off an inflammable vapour below 100° F. Benzol, likewise, though it may not be strictly an "oil," is, nevertheless, a product of coal, or, at any rate, of a bituminous substance—the tar of gas works—and therefore it would appear to come under the provisions of the Petroleum Act, whether kept or sold in large quantities for the manufacture of colours and other purposes, or in smaller quantities as a material for removing grease spots, &c. Though ether and spirit of wine both give off inflammable vapour below 100° F., they are not products of any of the materials specified in the 3rd clause of the act, and therefore would not come under its provisions.—BENJAMIN H. PAUL, 8, Gray's Inn Square, Feb. 8, 1869.

MEETINGS FOR THE WEEK.

- MONDAY, 15th.—Medical, 8.
London Institution, 6.
TUESDAY, 16th.—Royal Institution, 3. Mr. Westmacott, "On Fine Art."
WEDNESDAY, 17th.—Meteorological, 7.
Society of Arts, 8.
THURSDAY, 18th.—Royal Institution, 3. Dr. M. Foster, "On the Involuntary Movements of Animals."
London Institution, 6.
Royal, 8.30.
Zoological, 4.
Chemical, 8.
Royal Society Club, 6.
FRIDAY, 19th.—Royal Institution, 8. Mr. Greville Williams, "On the Female Poisoners of the Sixteenth and Seventeenth Centuries."
Geological, 8. Anniversary Meeting, 1.
SATURDAY, 20th.—Royal Institution, 3. Dr. Odling, F.R.S., "On Hydrogen and its Analogues."

TO CORRESPONDENTS.

** Dr. Odling's "Lectures on Carbon."—Owing to press of matter, the publication of these lectures is unavoidably suspended for this week.

Chemicus.—We know of no good work on the manufacture of pigment colours. Perhaps some correspondent could inform us if there is one.

Calcium.—A table of equivalents and a rule-of-three sum will answer the question as well as we could.

J. T. S.—The letter was unavoidably left standing over for some weeks, owing to great press of matter.

J. Sutherland.—We cannot give the information at present, but will insert the substance of your query.

J. W.—1. Doubtless there would be a little more demand for sodium at 3s. per pound than there is at present; but we do not think it would be worth any one's while to make it for that price, were the demand double what it is now. 2. Messrs. Roberts, Dale, and Co. hold the patent—apply to them. 3. The patent itself can be procured from the Patent Office for a few pence.

G. E. D.—1. Either the conversion of the benzol was incomplete, or the liquid you experimented upon was not benzol. There is no difficulty in making nitrobenzol from good materials. 2. As you are a student of chemistry, take our advice, and leave atoms and molecules alone for the present. Nobody knows how the atoms are arranged in elements of different atomicities. Graphic formulæ, diagrams, &c., are only artificial aids to fix certain properties of bodies on the memory; but no one intends them to represent the architectural plan and elevation of the body. Avoid theory: stick to experiment. 3. A compound, NH₄, is said to have been isolated. See the article, "Ammonium," in Watts's "Dictionary."

Communications have been received from Dr. R. Angus Smith, F.R.S.; J. J. Lish; L'Abbé Moigno; Dr. Adriani; J. J. Griffin and Sons; Dr. Rührig; J. Spiller; Prof. Heaton; W. H. Perkin, F.R.S.; R. R. Tatlock; W. F. R. Stock; Stevens, Bros.; C. G. Williams, F.R.S.; J. Watson; J. Sutherland; J. T. Sprague; J. Heywood; Drogheda Chemical Manure Works (with enclosure); Longmans and Co.; Dunn and Co.; Tennant and Co.; Dr. S. Muspratt; J. T. Bouck (with enclosure); W. Little; F. S. Jerningham (with enclosure); W. Blythe (with enclosure); Calvert and Co. (with enclosure); Demuth and Co.; H. Smith; F. A. Pooley (with enclosure); W. Hunter (with enclosure); W. E. Bickerdike (with enclosure); and C. Hunter.

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HEATON'S STEEL AND IRON PROCESS IN ITS PRESENT STATE.

THE great and general interest created by Heaton's process is proportionate with its great scientific and commercial object, which is nothing more or less than the production of good useful steel and wrought-iron from impure pig-iron. The use of impure pig is the chief point which distinguishes Heaton's process from other old and modern steel processes, as these have all required the employment of pure iron, or iron ore especially free from phosphorus and sulphur; this requirement very much limits the application of the otherwise highly valuable process of Bessemer.

Heaton's process differs from Bessemer's in employing nitrate of soda as the oxidising agent instead of atmospheric air, and both processes aim at the conversion of large masses at a time. As the great majority of existing iron works produce iron more or less contaminated with phosphorus and sulphur, Heaton's process would find an extensive field of operation if it were found fully to come up to what its promoters profess.

Our present knowledge of the process is confined to experiments only, the results of which are stated in reports (partly preliminary) by Professor Miller, Dr. Mallet, and Mr. Kirkaldy, and also in public correspondence; from these sources we are obliged at present to obtain our information and to form our opinion, as we have not ourselves seen the working of the process.

Prof. Miller's preliminary report describes Heaton's process thus:—

"On the occasion of our (namely, his and Dr. Mallet's) visit to the works of Langley Mill, on the 10th of July, 1868, 6½ cwts. of Clay Lane forge pig, No. 4, were charged into a hot cupola which contained no other iron; and immediately 6½ cwts. of Stanton forge pig, No. 4 (produced from ⅔ of Northamptonshire brown ore, ⅙ of Chesterfield clay ore, and ⅙ of puddling cinder) was added, and the whole, when melted, was drawn off into a ladle, from which it was transferred to the *converter*.

"The '*converter*' is a wrought-iron pot, lined with fire-clay. In the bottom of it was introduced a mixture of 169 lbs. of crude nitrate of soda, 40 lbs. of siliceous sand, and 20 lbs. of air-slaked lime; but these proportions in practice are varied considerably. On the top of this mixture a cast-iron perforated plate, weighing 95 lbs., was placed. The converter was then securely attached to the open mouth of a sheet-iron chimney, and the melted iron from the cupola (sample of this marked No. 4) was poured in.

"In about two minutes a reaction commenced; at first a moderate quantity of brown nitrous fumes escaped, these were followed by copious blackish, then grey, then whitish fumes, produced by the escape of steam carrying with it, in suspension, a portion of the flux. After the lapse of five or six minutes, an intense deflagration occurred attended with a loud roaring noise, and a burst of a brilliant yellow flame from the top of the chimney. This lasted for about a minute and a half, and subsided as rapidly as it commenced. When all had become tranquil, the converter was detached from the chimney, and its contents were emptied upon the iron pavement of the foundry.

"The crude steel was in a pasty state and the slag fluid; the cast-iron perforated plate had become melted up and incorporated with the charge of molten metal.

"The slag had a glassy, blebby appearance, and a black or dark green colour in mass.

"A mass of crude steel from the converter was then subjected to the hammer (No. 7).

"About 4½ cwts. of the crude steel were transferred to an empty, but hot reverberatory furnace, where, in about an hour's time, it was raised to a welding heat, and forged into four blooms under the steam hammer, then rolled into square billets, which were cut up, re-heated, and rolled into finished bars, varying in thickness from 1 inch to ⅝ of an inch (No. 8).

"Three or four cwts. of the crude steel from the converter were transferred to a re-heating furnace, then hammered into flat cakes, which, when cold, were broken up and sorted by hand for the steel melter (No. 9).

"Two fire-clay pots, charged with a little clean sand, were heated, and into each 42 lbs. of the cake steel were charged. In about six hours the melted metal was cast into an ingot (10 B).

"Two other similar pots were charged with 35 lbs. of the same cake steel, 7 lbs. of scrap iron, and 1 oz. of oxide of manganese. These, also, were poured into ingots (10 C).

"The steel, 10 B and 10 C, was subsequently tilted, but was softer than was anticipated.

"These results, on the whole, are to be considered rather as experimental than as average working samples.

"I have, therefore, made an examination of the following samples only:—

- No. 4.—Crude cupola pig.
- „ 7.—Hammered crude steel.
- „ 8.—Rolled steely iron.
- „ 5.—Slag from the converter.

"I shall first give the results of my analysis of the three samples of metal:—

	Cupola Pig No. 4.	Crude Steel (7).	Steel Iron (8).
Carbon	2·830	.. 1·800	.. 0·993
Silicon with a little titanium	2·950	.. 0·266	.. 0·149
Sulphur	0·113	.. 0·018	.. traces
Phosphorus	1·455	.. 0·298	.. 0·292
Arsenic	0·041	.. 0·039	.. 0·024
Manganese	0·318	.. 0·090	.. 0·088
Calcium	—	.. 0·319	.. 0·310
Sodium	—	.. 0·144	.. traces
Iron (by difference)	92·293	.. 97·026	.. 98·144
	100·000	100·000	100·000

"It will be obvious from a comparison of these results that the reaction with the nitrate of soda has removed a large proportion of the carbon, silicon, and phosphorus, as well as most of the sulphur. The quantity of phosphorus (0·298 per cent) retained by the sample of crude steel from the converter which I analysed, is obviously not such as to injure the quality.

"The bar-iron (No. 9) was, in our presence, subjected to many severe tests. It was bent and hammered sharply round without cracking. It was forged and subjected to a similar trial, both at a cherry red and at a clear yellow heat, without cracking; it also welded satisfactorily.

"The removal of the silicon is, also, a marked result of the action of the nitrate.

"It is obvious that the practical point to be attended to is to procure results which *shall be uniform*, so as to give steel of uniform quality when pig of similar composition is subjected to the process. The experiments of Mr. Kirkaldy on the tensile strength of various specimens, afford strong evidence that such uniformity is attainable.

"I have not thought it necessary to make a *complete* analysis of the slag, but have determined the quantity of sand, silica, phosphoric and sulphuric acid, as well as the amount of iron it contains. It was less soluble in water than I had been led to expect, and it has not deliquesced, though left in a paper parcel.

"I found that of 100 parts of finely-powdered slag, 11·9 were soluble in water. The following was the result of my analysis:—

Sand	47.3
Silica in combination	6.1
Phosphoric acid	6.8
Sulphuric acid	1.1
Iron (a good deal of it as metal) ..	12.6
Soda and lime	26.1

100.0

"The result shows that a large proportion of phosphorus is extracted by the oxidising influence of the nitrate, and that a certain amount of the iron is mechanically diffused through the slag.

"The proportion of slag to the yield of crude steel was not ascertained by direct experiment, but, calculating from the materials employed, its maximum amount could not have exceeded 23 per cent of the weight of the charge of molten metal. Consequently, the 12.6 per cent of iron in the slag could not be more than 3 per cent of the iron operated on.

"In conclusion, I have no hesitation in stating that Heaton's process is based upon correct chemical principles. The mode of attaining the result is both simple and rapid. The nitric acid of the nitrate in this operation imparts oxygen to the impurities always present in cast-iron, converting them into compounds which combine with the sodium, and these are removed with the sodium in the slag. This action of the sodium is one of the peculiar features of the process, and gives it an advantage over the oxidising methods in common use."

The following is Dr. Mallet's opinion of the reality and commercial value of Heaton's process.

"This process for converting crude pig-iron into wrought-iron and into steel, by the employment of nitrate of soda, in Heaton's patent converter, has been repeated at Langley Mills many times, in my presence. I have examined minutely into its details as applicable in practice on a large scale, and its results; and I have also considered the chemical researches made as to the materials used and products obtained, by Professor Miller, of King's College, and I have been present at experiments, conducted by Mr. David Kirkaldy, at his Testing Works, at Southwark, as to the physical qualities of the products which were obtained by this process, in my own presence, at Langley Mills. In view of all the facts that have come before me, I can affirm the following as truths established beyond question:—

"1st. That Heaton's patent process of conversion by means of nitrate of soda, is at all points in perfect accord with metallurgic theory. That it can be conducted upon the great scale with perfect safety, uniformity, and facility, and that it yields products of very high commercial value.

"2nd. That in point of manufacturing economy or cost it can compete with advantage against every other known process for the production of wrought-iron and steel from pig-iron.

"3rd. Amongst its strong points, however, apart from and over and above any mere economy in the cost of production are these:—It enables first-class wrought-iron, and excellent steel to be produced from coarse, low-priced brands of crude pig-irons, rich in phosphorus and sulphur, from which no other known process, not even Bessemer's, enables steel of commercial value to be produced at all, nor wrought-iron, except such as is more or less either "cold-short" or "red-short." Thus, wrought-iron and cast-steel of very high qualities have been produced, in my presence, from Cleveland and Northamptonshire pig-irons rich in phosphorus and sulphur, and every iron-master, I presume, knows that first-class wrought-iron has not previously been produced from pig-iron of either of these districts, nor marketable steel from them at all.

"Heaton's process presents, therefore, an almost measureless future field in extending the manufacture of high class wrought-iron and excellent steel into the Cleveland, and other great iron districts, as yet precluded from the production of such materials by the inferior nature of

their raw products. It admits of the steel manufacture also being extended into districts and countries where fuel is so scarce and dear that it is otherwise impossible.

"I cannot, in this brief communication, point out the prospects which the employment of this system presents of greatly diminishing the existing waste of material, fuel, time, and wages, in the puddling process, and of lessening difficulties in relation to labour questions which beset that process, injuriously to the British iron trade. Nor can I adequately point out the large reduction in the original outlay for plant which this system admits of as compared with any other for equal annual out-put of iron and steel.

"Dr. Miller has proved, incontrovertibly, that the Heaton process does eliminate from the crude pig-iron almost the whole of the phosphorus and sulphur, the trace remaining being unobjectionable in the wrought-iron and steel produced, even when they have been made from the pig-irons known to be the richest in these injurious constituents of any make in Great Britain.

"The wrought-iron made in my presence from Cleveland and Northampton pigs and tested for tensile resistance also before me, bore a rupturing strain of 23 tons per square inch, and an elongation of nearly $\frac{1}{4}$ of the original unit in length. It is therefore iron of great strength and toughness, and yet probably by no means the very best that this process is capable of producing hereafter. It possesses those qualities which best fit iron for artillery, armour plates, and iron ships or boilers.

"The tilted cast-steel also made in my presence, from the very same pig-irons as the above, bore a tensile strain at rupture of above 42 tons per square inch with an elongation of $\frac{1}{2}$ th of the unit of length. It is, therefore, a remarkably tough and fine quality of steel, well suited for rails, ship-building, and all other structural uses. In a word, steel suited for any purpose known to the arts can be produced by this system from very inferior brands of pig-iron, from such as by no other known process could serviceable steel be made at all."

Mr. Kirkaldy has tested not only the bars of steel and steel-iron made in the presence of Dr. Miller and Dr. Mallet, but a number of other bars made by Heaton's process from different brands of pig-iron. The results of these experiments are given in the following tables:—

DESCRIPTION.	MEAN BREAKING WEIGHT PER SQUARE INCH.		CONTRACTION OF AREA.	EXTENSION IN 10 INCHES.	APPEARANCE OF FRACTURE.
	lbs.	tons.		p.c.	p.c.
1. Hammered cast-steel—made in the presence of Messrs. Miller and Mallet. Average of 5 samples	95,414	42.6	9.3	7.7	granular.
2. Ditto—made from 13 cwts. <i>Glengarnock Pig</i> , No. 2 (Scotch). Average of 2 samples	99,481	44.4	16.9	8.5	{ 55 p.c. silky; 45 p.c. granular.
Average of 2 samples	84,877	37.8	3.9	4.1	{ granular. (peculiar).
3. Ditto—made of 7 cwts. of <i>Workington Pig</i> , No. 1, and 6 cwts. of <i>Stanton Forge Pig</i> , No. 4, mixed in the cupola in the usual way. Average of 3 samples.	92,961	41.5	13.9	7.6	{ granular (the weakest of the 3 sample bars was 75 p.c. silky.)
4. Ditto—made from a charge of <i>Round Oak Pig-iron</i> only; the quantity of nitrate of soda used was 10 p.c. Average of 6 sample bars (0.77 × 0.78)	90,478	40.4	1.9	1.0	granular.

DESCRIPTION.	MEAN BREAKING WEIGHT PER SQUARE INCH.		CONTRACTION OF AREA.	EXTENSION IN 10 INCHES.	APPEARANCE OF FRACTURE.
	lbs.	tons.			
			p.c.	p.c.	
5. Ditto—made from a charge of 13 cwts. of <i>Butter-leg Iron</i> , with 10 p.c. of nitrate of soda; 8 bars were made from the cakes melted in the crucible, and tilted into 4 bars of 1 in. and 4 bars of $\frac{1}{2}$ in. squares. Average of 4 bars of $\frac{1}{2}$ in. square ..	100,019	44.7	11.4	5.5	granular.
Average of 4 bars 1 in. square ..	85,964	38.3	3.1	2.6	ditto.
6. Ditto—made from a charge of 13 cwts. of <i>Dowlais Iron</i> (No. 2), with 10 p.c. of nitrate of soda; 8 bars were made from the cakes melted in the crucible, and tilted in 4 bars of 1 in. and 4 bars of $\frac{3}{4}$ in. square. Average of 4 bars $\frac{3}{4}$ in. square ..	95,470	42.6	3.2	2.5	granular.
Average of 4 bars 1 in. square ..	82,438	36.8	2.5	1.3	ditto.
7. Ditto—made from a charge of 13 cwts. of <i>Dowlais Pig Iron</i> (No. 3), with 10 p.c. of nitrate of soda; 12 bars were made from cakes melted in the crucible, and tilted into 4 bars of 1 in., $\frac{3}{4}$ in., and $\frac{1}{2}$ in. square. Average of 4 bars $\frac{1}{2}$ in. square ..	112,875	50.4	7.6	2.3	granular.
Average of 4 bars $\frac{3}{4}$ in. square ..	91,096	40.7	2.9	1.2	ditto.
Average of 4 bars 1 in. square ..	79,480	35.5	2.0	0.8	ditto.
8. Ditto—made from a charge of 13 cwts. of <i>Middlesboro' (No. 4) Forge Pig Iron</i> , with 10 p.c. of nitrate of soda; 12 bars were made from cakes melted in the crucible, and tilted into 4 bars of 1 in., $\frac{3}{4}$ in., and $\frac{1}{2}$ in. square. Average of 4 bars $\frac{1}{2}$ in. square ..	119,699	53.4	18.3	10.3	{ granular (peculiar).
Average of 4 bars $\frac{3}{4}$ in. square ..	99,938	44.7	5.8	4.2	ditto.
Average of 4 bars 1 in. square ..	96,713	43.2	5.8	4.4	ditto.
9. Ditto—made from pure <i>Workington Hæmatite Pig Iron</i> , with $7\frac{1}{2}$ p.c. of nitrate of soda; 6 bars $\frac{1}{2}$ in. square made as the other bars before tested. Average of the 6 bars ..	108,489	48.4	5.8	2.7	granular.
10. Ditto—made from White Forge Pig, produced from oolite ore, at the works of Baron d'Adelswärd, at Longwy, Moselle, France. The charges of nitrate of soda were as under.					

No. I.		c.	qr.	lb.
Longwy	White			
Forge Pig ..		14	2	0
Perforated plate,				
Clay Lane ..		1	0	0
		15	2	0
Nitrate of Soda ..		1	1	10

DESCRIPTION.	MEAN BREAKING WEIGHT PER SQUARE INCH.		CONTRACTION OF AREA.	EXTENSION IN 10 INCHES.	APPEARANCE OF FRACTURE.
	lbs.	tons.			
			p.c.	p.c.	
No. II.					
Longwy	White	c.	qr.	lb.	
Forge Pig ..		14	2	0	
Perforated plate,					
Clay Lane ..		1	0	0	
		15	2	0	
Nitrate of soda ..		1	0	26	
No. III.					
Longwy	White	c.	qr.	lb.	
Forge Pig ..		14	2	0	
Perforated plate,					
Clay Lane ..		1	0	0	
		15	2	0	
Nitrate of soda ..		1	0	20	
No. IV.					
Longwy	White	c.	qr.	lb.	
Forge Pig ..		14	2	0	
Perforated plate,					
Clay Lane ..		1	0	0	
		15	2	0	
Nitrate of soda ..		1	0	1 $\frac{1}{2}$	
12 bars of $\frac{1}{2}$ in. cast-steel were made from No. 2 and No. 3 charges. Average of 6 bars ..					
		116,330	52.0	6.3	4.0 { granular (peculiar).
Average of 6 bars ..					
		120,864	49.5	30.1	12.5 { granular and silky.
11. Cast-steel, hammered, made from 3 charges of Grey Foundry Iron, produced at the works of M. de Wendel and Co., at Hayange, Moselle, France, from oolite ore, similar to the Northamptonshire ore, with charges of nitrate of soda in the following proportions:—					
No. I.					
Hayange	Grey	c.	qr.	lb.	
Foundry Pig ..		14	2	0	
Perforated plate of					
Cleveland Pig ..		1	0	0	
		15	2	0	
Nitrate of soda ..		1	1	10	
No. II.					
Hayange	Grey	c.	qr.	lb.	
Foundry Pig ..		14	2	0	
Perforated plate of					
Cleveland Pig ..		1	0	0	
		15	2	0	
Nitrate of soda ..		1	2	2	
No. III.					
Hayange	Grey	c.	qr.	lb.	
Foundry Pig ..		14	2	0	
Perforated plate of					
Cleveland Pig ..		1	0	0	
		15	2		
Nitrate of soda ..		1	3		

DESCRIPTION.	MEAN BREAKING WEIGHT PER SQUARE INCH.		CONTRACTION OF AREA.	EXTENSION IN 10 INCHES.	APPEARANCE OF FRACTURE.
	lbs.	tons.			
The steel bars were made as before stated.					
Average of 4 bars $\frac{1}{2}$ in. square	114,123	50.9	5.6	3.1	{ granular (peculiar).
Average of 4 bars $\frac{1}{2}$ in. square	112,590	50.3	5.6	3.2	ditto.
Average of 4 bars $\frac{3}{4}$ in. square	84,740	37.8	2.6	1.3	ditto.
12. Cast-steel, hammered, made from a charge of 15 cwts. of white forge pig produced from oolite ore at the works of Baron d'Adelswärd, at Longwy, France, treated with 1 cwt. 25 lbs. of nitrate of soda. The 6 bars of steel were made from cakes melted in the crucible, and tilted into $\frac{1}{2}$ in. square bars. Average of the 6 bars	109,951	49.1	8.7	6.0	granular.

Rolled steel-iron produced from the same kinds of pig-iron as the above-named, for the production of cast-steel, bore a rupturing strain of from 20.5 to 23.6 tons, and a contraction of area of from 14.2 to 49.6 per cent, and an extension of from 6.1 to 28.3 per cent. Hammered steel-iron of the same kind bore a rupturing strain of from 20.8 to 24.5 tons, a contraction of area of from 23.1 to 42.3 per cent, and an extension of from 11.3 to 23.6 per cent.

The following are the results of experiments on the tensile strength of various other kinds of iron and steel of known character made by Mr. Kirkaldy, and which we give here for the sake of comparison:—

NAMES.	MEAN BREAKING WEIGHT PER SQUARE INCH. Tons.	CONTRACTION OF AREA. Per cent.
<i>a. Steel.</i>		
Turton's cast-steel for tools (forged)	59.3	.. 4.7
Jowitt's double shear steel (forged)	52.9	.. 19.6
Bessemer's patent steel for tools (forged)	49.8	.. 22.3
Wilkinson's blister steel (forged)	46.6	.. 21.4
Krupp's cast-steel for bolts (rolled)	41.1	.. 34.0
Jowitt's spring steel (forged) ..	32.4	.. 24.1
Mersey Company's puddled steel (forged)	31.9	.. 35.3
Blockairn puddled steel (forged)	28.0	.. 11.9
<i>b. Wrought Iron (round and square bars).</i>		
Yorkshire Low Moor	27.5	.. 49.8
„ Bowling		
„ Farnley		
Lanarkshire \diamond Govan \diamond	26.0	.. 49.4
Lancashire best rivet	24.0	.. 48.6
Staffordshire charcoal (4)	25.6	.. 60.9
„ BB scrap	26.5	.. 52.0
Durham Best Best	23.9	.. 18.3
Ditto	22.6	.. 11.7
South Wales	18.5	.. 9.8

When comparing these results with those obtained with Heaton's steel and iron it will be seen that Heaton's products are somewhat harder, as the contraction of area is

generally greatest with the toughest and softest kinds. But on the whole the experiments before us are very satisfactory if we consider that Heaton's sample bars have been made experimentally only, and are consequently at a disadvantage with those of a regular manufacture, and if we further take into consideration the following circumstances influencing the tensile strength or tenacity of steel, and which can be followed better in a regular manufacture than in simple experiments:—

The Degree of Hardness.—Whilst a bar of unhardened good steel, 1 square inch (Prussian) in section, ruptures at a strain of 120,000 Prussian lbs. (wrought-iron bears only about 59,000 lbs.), the tenacity may be increased to 150,000 lbs. by properly hardening the steel. On the other hand, the tenacity decreases to 110,000 lbs. when the steel is hardened too much. The greatest hardness is therefore not combined with the greatest tenacity.

The Amount of Carbon contained in the Steel.—The cohesion of steel increases with its amount of carbon up to 1.4 per cent, but beyond this limit the tenacity again decreases.

The Mechanical Treatment of the Steel.—Steel will be stronger and more homogeneous the longer and the more frequently it is forged.

The nature of the raw materials employed, and consequently the foreign substances contained in steel, also exercise an influence on the quality.

Professor Miller has analysed the *steel iron*, whose tensile strength has been ascertained by Mr. Kirkaldy to be 23 tons per square inch, a statement by no means contradictory to the composition of the iron as shown by the analysis. We much regret that Professor Miller has not also made an analysis of the *hammered cast-steel* whose tensile strength was found by Mr. Kirkaldy to be 43 tons per square inch.

These bars of cast-steel are thus described in Dr. Mallet's certificate of identification:—

"I certify that certain round rolled bars of Heaton's Patent Steel Iron, marked and numbered, and also certain bars of *rolled cast-steel* and square bars of *tilted cast-steel*, also marked and numbered, were made on the 10th of July, 1868, at Langley Mills Steel Works, by Mr. Heaton's patent process, in my presence, and in that of Dr. Miller (except in so far as that Dr. Miller, through illness, was unable to wait for the 'pouring' and tilting, &c., of the cast-steel), that the whole were made from a mixture of equal weights of Clay Lane No. 4 (Cleveland's) pig-iron, and of Stanton (BBB Pig) Northamptonshire iron, treated in Heaton's Patent Converter, and that the above bars of steel iron and cast steel were forwarded thence, in cases under my seal to Mr. Kirkaldy's Testing Works, London. That I there identified the said bars when taken out of the case in my presence, and that certain of those bars were tested before me as to the breaking strain and amount of elongation by Mr. Kirkaldy, and that the results of such testings are those referred to in my 'Preliminary Report.'"

These bars, therefore, most probably belong to the steel which Professor Miller's preliminary report designates as 10 B or 10 C, or the bars were perhaps taken from both kinds; neither of them has been analysed, although this appears to be absolutely required to clear up the doubt still hanging over Heaton's cast-steel, concerning its proportion of phosphorus. It is rather an enigma, that, in the controversy on the value of Heaton's process, which has been carried on for some time in different periodicals and newspapers, Professor Miller's analysis of the crude steel has been taken as a basis for judging the hammered cast-steel, which undoubtedly has a different composition and less impurities than the original crude steel. We perfectly coincide with the opinion that part of the impurities are contained in the crude steel as intermixed or disseminated slag, and it remains to be proved how far these impurities, especially phosphorus, have been eliminated by the subsequent treatment of crude steel as described by Drs. Miller and Mallet.

The elimination of phosphorus is said to be one of the striking features of Heaton's process, but Professor Miller's analyses would appear to show that, on this special point, Heaton's process has no advantage over the common puddling process.

According to Professor Miller's analyses, the pig-iron employed contained 1.455 per cent of phosphorus, which proportion was reduced in the crude steel to 0.298 per cent, and in the steel-iron to 0.292.

For the sake of comparison, we give the following results of the puddling process:—

I. According to analyses of Calvert and Johnson:—

	Fe.	C.	Si.	S.	P.
Pig-iron	94.052	2.275	2.720	0.311	0.645
Blooms	99.338	0.269	0.120	0.134	0.139
Finished iron..	99.490	0.111	0.088	0.094	0.117

II. The following is the result of Mr. Willis's analysis, made in Mr. Siemen's laboratory at Birmingham, of an inferior English pig-iron, before and after being puddled:—

PIG METAL.			PUDDLED BARS.		
Sulphur	0.08		Sulphur	0.017	
Phosphorus ..	1.16		Phosphorus ..	0.237	
Silicon	1.97		Silicon	0.200	
Iron and carbon (by difference)	96.79		Iron (by difference)	99.546	

III. In Ure's "Dictionary of Arts and Mines," ii., 726, the following illustrations are quoted:—

Pig-iron	3.030 per cent of phosphorus.
Puddled bar ..	0.838
Rough down bar	0.572

The finished bar was cold-short in the highest degree.

	Phosphorus.	Manganese.
	Per cent.	Per cent.
Pig-iron containing	2.60 ..	7.20
Puddled bar ..	0.30	0.30
Ditto	0.20	
Finished bar ..	0.11	

The finished bar exhibited none of the cold-short quality; it was exceedingly ductile; indeed, excellent horse-shoes were made from it.

Another question, important to Heaton's process, is to know the exact proportion of phosphorus that wrought-iron and steel may safely contain without being injured in their physical properties; and we are sorry to state that that proportion requires further investigation, although no research can ever lead to the determination of a definite amount, for the following reason:—Iron containing phosphorus, takes, upon cooling, a crystalline texture, and thus becomes brittle or cold-short; but if forged immediately after heating, the crystalline texture and the cold-shortness will be lessened, and the more so the longer the iron is under the hammer.

Different investigators have recorded their opinions upon the influence of phosphorus upon wrought-iron and steel, thus:—

According to Karsten, there is little cause for apprehension respecting the quality of iron, as long as the phosphorus is below 0.5 per cent, and the only effect of a proportion of phosphorus up to 0.3 per cent is to make the iron harder without greatly diminishing its tenacity; and Karsten considers iron, containing not more than the latter proportion of phosphorus, as belonging to the best and strongest quality. He states, furthermore, that iron containing 0.5 per cent still stands the breaking test, but not when containing 0.6 per cent; this iron, however, can be bent at right angles, and struck over the anvil; and that containing from 0.75 to 0.80 per cent shows decided cold-shortness. Iron containing 1 per cent is very brittle, and can only be applied to a few uses.

According to Eggertz, wrought-iron containing from 0.25 to 0.3 per cent of phosphorus shows some cold-shortness, but is fit for various fine forge purposes, such as the manufacture of nails, wire, &c.

Eggertz also states that most varieties of steel of high repute contain from 0.01 to 0.02 per cent of phosphorus.

Bauerman, in his treatise on "The Metallurgy of Iron," p. 29, states:—

"Wrought-iron containing not more than 0.3 per cent of phosphorus is not sensibly affected in tenacity, but is only rendered somewhat harder; with 0.5 per cent it becomes somewhat cold-short, or incapable of being wrought cold under the hammer without breaking; with 0.8 per cent, the cold-shortness is very decided, and 1 per cent makes the metal very brittle."

Concerning Bessemer steel, Bauerman states, on page 365:—

"The best English pig-iron for use in the Bessemer process is that smelted from Cumberland hæmatite, about No. 1 or No. 2 in greyness. It should contain from 1½ to 2 per cent of silicon as a minimum, and not more than 0.2 per cent of phosphorus. At Essen, in Westphalia, the limiting quantities of foreign matters in the pig-iron preferred for Bessemer steel making, are, according to Jordan, as follows:—

Manganese	maximum	..	1.00 per cent.
Sulphur ..	..	..	0.04 ..
Phosphorus	..	..	0.06 ..
Carbon ..	minimum	..	5.00 ..
Silicon ..	..	..	2.00 ..

Concerning the Bessemer process, it is stated in Ure's "Dictionary of Arts and Mines," vol. iii., 770:—"As different samples were carefully analysed, it was ascertained that the red-shortness was always produced by sulphur, when present to the extent of 1-10th per cent, and that cold-shortness resulted from the presence of a like quantity of phosphorus."

It is greatly to be desired that Mr. Bessemer should publish his unquestionably rich experience of the influence of phosphorus and sulphur on steel.

We have already shown by analyses that the results of Heaton's process with regard to the elimination of foreign matters are similar to those of the puddling process. This, most probably, is the case, as the wrought-iron in both processes is produced in a pasty state, differing from the Bessemer process, which yields the wrought-iron in a liquid state.

Mr. Kirkaldy's experiments classify the one product of Heaton's process under wrought-iron, and the other under steel, as the former breaks at a burden of 23 tons per square inch and the latter at 43 tons, which is perfectly conformable with experience. However, we should like to have seen some further experiments on other qualities of the products of Heaton's process, such as property of welding, hardening, &c. And, though we consider the process open to improvement, it is, at all events, a step towards increasing the value of the inferior kinds of pig-iron; and it promises great results. To promote such an object is, we think, but just and fair, and, accordingly, we have endeavoured, in the preceding review, to give an impartial examination of the present state of the Heaton process.

We propose to give in a subsequent article the detailed statements of the actual cost of making steel and wrought-iron by this process.

In conclusion, we may state that an impartial French commission, headed, with the sanction of the French government, by M. Gruner, *Inspecteur-Général des Mines* of France, and Professor of Metallurgy in the Imperial School of Mines, has witnessed the conversion of their own impure pig-iron into steel, and verified the cost of production. A report of that commission is expected shortly, which will doubtless assist in elucidating the present obscure points in Heaton's process. We understand that M. Gruner has already reported that a sample of the slag was found to contain about 12 per cent of phosphoric acid—sufficient, indeed, to make it valuable as a source of that acid.

ON FOOD.*

By DR. LETHEBY, M.A., M.B., &c.

(Continued from p. 77.)

Unwholesome and Adulterated Food.

OCCASIONALLY we have examples of food which is of itself poisonous. This is so with many of the fish in tropical seas, and especially of the West Indies. Dr. Burrows has given us a long list of them; and it would seem that the yellow-billed sprat (the Sardine doré of the French, and *Clupea thryssa* of naturalists), the toad or bladder-fish (*Aplodactylus punctatus* or *Tetraodon* of Cuvier) and the grey-snapper (*Coracinus fuscus major*) are the most venomous; and that being eaten by larger fish, as the *Baracosta*, and various species of perch, as well as the conger-eel, the dolphin, the globe fish, &c., it causes these to be poisonous also. The yellow-billed sprat is so virulent in its action on the human body that both Europeans and negroes have been known to expire with the fish in their mouths unswallowed; and the toad or bladder-fish, is scarcely less dangerous. Sir John Richardson has described the effects of it on two sailors, the boatswain's mate and purser's steward, of the Dutch brig of war, *Postilion*, while lying at anchor in St. Simon's Bay, at the Cape of Good Hope, in September, 1845. The men were warned that the fish was poisonous, but believing that the liver was wholesome, and rather a delicacy, they cooked it, and ate it directly after their twelve o'clock dinner. In ten minutes the boatswain's mate was so ill that he could not stand; his face was flushed, his eyes glistened, his lips were swollen and rather blue, his forehead was covered with a cold perspiration, and his pulse was weak and fluttering. He was, however, quite conscious, and complained of pain and constriction of the throat, and he had a desire to vomit. In a few minutes more he became paralysed, his eyes were fixed, his breathing was laborious, his face was pale though his lips were livid, and in seventeen minutes he was dead. The other man exhibited the same symptoms, and died in twenty minutes. Sir John Richardson says the fish was not more than six or eight inches in length, and the liver of it, which they had eaten between them, could not have weighed more than half an ounce.

The symptoms occasioned by the poisonous fish of the tropics are always of two kinds—there is either great irritation of the stomach and bowels, like cholera; or there is rapid prostration of the vital powers, and death by syncope or convulsions. These effects have been long known both to natives and Europeans, and were called by the Spanish colonists of tropical America, *Siquatera*. They are more frequently observed at certain seasons of the year than at others, and hence they are thought to be due to certain physiological changes in the body of the fish, or to the food which it has eaten. In some cases the roe, in others the liver, or the digestive organs, are the most poisonous parts of the fish; and in the case of the *Maletta venenosa*, which inhabits the Caribbean Sea, it is only poisonous when the sea is covered with a green monad, upon which the creature feeds. Happily for us, these dangers are confined to the tropics, although we sometimes suffer from a milder form of disturbance, as irritation of the skin and bowels, from eating unwholesome shell-fish.

Putrid meat is, perhaps, wasteful rather than actually injurious; but there are plenty of cases in which it has caused disease. Foderè tells us that at the siege of Mantua, those who were shut in the city, and were obliged to eat the half-putrid flesh of horses, suffered from gangrene and scurvy; and in Czant's history of Greenland there is an account of the death of thirty-two persons at a missionary station called Kangek, from a repast on the putrid brains of a walrus. Similar cases are recorded in all the books

on legal medicine. Even game, when only sufficiently tainted to please the palate of the epicure, has caused severe cholera in persons unaccustomed to it; but, as Dr. Christison observes, "the power of habit in reconciling the stomach to the digestion of decayed meat is inconceivable. Some epicures in civilised countries prefer a slight taint even in their beef and mutton; and there are tribes of savages still further advanced in the cultivation of this department of gastronomy, who eat with impunity rancid oil, putrid blubber, and stinking offal." The Zulus of Natal, according to Dr. Colenso, are so fond of putrid meat that they call it *ubomi*, which literally means to be superlatively happy. But, as a rule, there is a natural abhorrence of tainted food, insomuch, that with most persons, the mere commencement of decay is sufficient to excite disgust; and rarely do we find, except among savages, that an entire meal is made of putrid flesh. A little game or venison, or ripe cheese, at the end of a feast, with just a piquant touch of decay, is, perhaps, not objectionable; for it may, as Liebig supposes, promote digestion, by communicating its own quality of transformation to the rest of the food; but it is another thing to fill the stomach with putrid flesh, for if the corrective power of the gastric juice should fail, the effect of it might be serious. We have, indeed, abundant evidence of the terrible consequences of admitting putrid matter into the circulation, for they were once too common among those engaged in the dissection of the human body. In fact, the mere handling of decomposing animal matter for any time, will often produce disease of the hands or other parts of the body with which it comes into contact. Our safety, perhaps, in using such food is in the antiseptic power of good cooking; but this is not always an easy affair; for the tissues are generally so soft from decay that they will hardly bear the common action of heat; so that if they be boiled for any time they will fall to pieces; and if they be roasted, they will shrink without forming that delicious crust of osmazome which is characteristic of good meat. Let them, however, be cooked as they may, they always require a nice adjustment of rather strong flavours to make them palatable; and those who have dined in the cheap restaurants of Paris, or at the still worse table d'hôte of a German watering-place, will have experienced the art of the cook in this respect, in such dishes as *turbot en vol-au-vent*, *Raie au beurre noir*, *sole en matelote Normande*, and in the various forms of fish *au gratin*; or game *en salmis*.

But bad as this sort of tainted food is, it is nothing in comparison to the sausage poison, which is produced by a sort of modified putrefaction, to which the large sausages of Germany, and especially those of Würtemberg, are occasionally subject. According to an official return, there have been more than 400 cases of poisoning from these sausages in Würtemberg alone during the last fifty years, and of these about 150 were fatal. The effects are generally observed in spring, and mostly in April, when the sausages become musty, and acquire a soft consistence in the interior. They have also a peculiarly nauseous and rather putrid taste, and are very acid to test-paper. If eaten in this condition, they produce dangerous effects in from twelve to twenty-four hours—the first symptoms being pain in the stomach, with vomiting and diarrhœa, and dryness of the nose and mouth; then comes a feeling of profound depression, with coldness of the limbs, weakness and irregularity of the pulse, and frequent fainting. Fatal cases end with convulsions and oppressed breathing between the third and eighth day. The precise cause of these effects is still a mystery; some have thought that rancid fatty acids are produced during the decomposition of the meat; others that in the process of drying and smoking acrid pyrogenous acids have been developed; others that during the decay of the sausages, a poisonous organic alkaloid is generated. Liebig is of opinion that the effects are due to an animal ferment, which produces in the blood, by catalysis, a state of putridity analogous to its own, and that the molecular movements of the putrefactive change in the decaying meat are thus com-

* The Cantor Lectures, delivered before the Society of Arts.

municated to the living organism. M. Vanden Corput, who is one of the most recent investigators of the subjects, attributes the morbid action of such meat to the presence of a minute fungus, of the nature of a sarcina, which he calls *sarcina botulina*. This view is confirmed by the fact that there is always a peculiar mouldiness of the sausages; and the poisonous property is generally observed in April, when these cryptogamic organisms are most freely developed.

Similar effects have occasionally been produced by other kinds of animal food—as veal, bacon, ham, salt-beef, salt-fish, cheese, &c., and the food has usually been in a decayed and mouldy condition. It would be tedious if I were to detail, or even to enumerate the cases recorded by medico-legal writers; but I may, perhaps, refer to a few of them. In 1839, there was a popular fête at Zurich, and about 600 persons partook of a repast of cold roast veal and ham. In a few hours most of them were suffering from pain in the stomach, with vomiting and diarrhoea; and before a week had elapsed, nearly all of them were seriously ill in bed. They complained of shivering, giddiness, headache, and burning fever. In a few cases there was delirium; and when they terminated fatally, there was extreme prostration of the vital powers. Careful inquiry was instituted into the matter, and the only discoverable cause of the mischief was incipient putrefaction and slight mouldiness of the meat. Dr. Geiseler relates an instance where a family of eight persons were made ill by musty bacon; and M. Ollivier has given an account of six persons who were poisoned by mutton in a state of modified decay—four of whom died from it within eight days. In Russia, where it is the practice to eat largely of salt-fish in a raw condition, it is not at all uncommon to witness the dangerous effects of it when it has become mouldy or putrid; and, in fact, it is within the experience of every one who is concerned in medico-legal inquiries, that serious symptoms are frequently traced to the use of food in a modified condition of decay. This is especially so with bad cheese, the effects of which on the constitution have been so severe that official investigations have been called for. These effects have been noticed at Schwerin (1823), at Minden (1825), at Hameln (1826), at Griefswald (1827), Frankfort (1828), and elsewhere; and they have been the subjects of interesting essays by Henneman, Hünefeld, Westrumb, and others. At first the effects were attributed to the copper vessels used in the dairies, and therefore the Austrian, Würtemberg, and Ratisburg States prohibited the use of that metal for such purposes; but the subsequent inquiries of Hünefeld, Sertürner, and other chemists, established the fact that no metallic poison was discoverable in the cheese. In the police report, which was published in Frankfort, in January, 1828, informing the public of numerous cases of poisoning in that city from spoiled cheese, it was declared that no poisonous principle could be detected by chemical reagents. Professor Hünefeld and, subsequently, Sertürner, were of opinion that the effects were due to certain poisonous fatty acids analogous to, if not identical with, caseic and sebacic acids; and they even describe the way in which they are produced in the cheese during the process of ripening—attributing them to the imperfect removal of the acid liquor from the curd when the cheese was made, or to the putrefaction of the curd before it was salted, or to the mixture of flour with the curd; but it is far more likely that the poisonous effects are due, as Vanden Corput supposes, to the presence of a peculiar mould or fungus. I have myself seen the most terrible consequences from the use of such cheese, and have failed to discover anything unusual in the acidity or other chemical reactions of the cheese. Hünefeld says, it is commonly of a yellowish red colour, and is soft and tough, with harder and darker lumps interspersed throughout it, and it has a disagreeable taste, and an acid reaction. The symptoms which it produces are very much like those of sausage poisoning—namely, irritation of the stomach and bowels, with great

prostration of the vital powers. These effects have been witnessed not only in Germany, where the cheese is generally rancid and bad, but also in this country, and particularly among the small hill-farms of Cheshire, where the limited extent of the dairies obliges the farmer to keep the curd for several days before a sufficient quantity of it is accumulated to make a large cheese.

I have said nothing of the improper practice of killing very young animals, especially calves, for food, before the tissues have had time to change from their uterine condition. On the Continent it is unlawful to kill or to sell calves for food that are not more than fourteen days old, but in this country there is no such restriction, and it is a common practice to dispose of the carcasses of newly-born or even foetal calves to the sausage maker; and as the flesh is sodden and insipid, he strengthens it with old, tough, and sinewy flesh. It has the advantage, moreover, of being miscible with any description of meat, and of taking any variety of flavour; in fact, it makes just that kind of sausage which is susceptible of any kind of flavour, and where, to use the expression of Dickens, "It's the seasonin' as does it." I cannot say that such meat is positively unwholesome, but it is nasty, and excites the same sort of disgust as an egg with a chick in it.

(To be continued).

ON THE CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(ADAPTED TO A JUVENILE AUDITORY),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN,
(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, Esq., M.B., F.R.S.

(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE IV.

CARBONIC GAS, OR FIXED AIR.

Changes of charcoal itself, as distinguished from changes brought about by charcoal—Its little liability to change under ordinary circumstances—Its susceptibility to action of strong chemical agents—Change of charcoal into carbonic gas by its combustion or burning—Combustion of charcoal set up at very moderate temperatures—Its slow or rapid combustion in air according to circumstances—Its brilliant combustion in oxygen—Properties of resulting carbonic gas—Its usual production from chalk or marble—Its combination with lime to reproduce chalk—Its power of extinguishing flame—Its solubility in an equal measure of water—Its increase of solubility in water by increase of pressure—Effervescent waters made by saturating different waters with carbonic gas under pressure—Effervescence due to escape of excess of carbonic gas on removal of pressure—Residuary carbonic gas expelled on boiling the water—Solubility of chalk in water saturated with carbonic gas—Occurrence of so-dissolved chalk in most natural waters—Its deposition as boiler-

* Reported verbatim, by permission of the Author, for this Journal.

fur on boiling such waters—Carbonic gas, or fixed air, one and a half times as heavy as common atmospheric air—Various illustrations of its heaviness—Its capability of being poured through air, as a heavy liquid may be poured through a light one—Its outflow through a tap, transference through a syphon, baling out by a cup, &c.—Floating of air on carbonic gas, as of spirit on water—Gradual mixing of air with carbonic gas, and their non-separation after admixture.

You will remember that ordinary atmospheric air is a mixture of two different kinds formerly called vital and non-vital air,—or rather, instead of saying “non-vital,” chemists used the word *azotic*, derived from the Greek. Vital air is now called *oxygen*, and the azotic is called *nitrogen*. When bodies burn in air they combine with the oxygen of the air, or, in other words, become oxidised, so that when you say a body is burnt in air, it is almost the same thing as saying that it is oxidised, for the fact of its being burnt implies that it becomes oxidised. Now, all the ordinary substances which we are in the habit of burning for the sake of getting either light or heat, consist substantially of carbon and hydrogen, though these do not form their exclusive constituents, as they frequently contain other elements as well. The carbon and hydrogen are in an unburnt or substantially unoxidised condition. This candle, for example, although it is perfectly white, contains a very large amount of carbon, and there is nothing more remarkable in the white candle containing carbon than there is in the white marble containing it. The only point of difference is, that in the marble the carbon is already oxidised or burnt, and in the candle it is not. When we light a candle we oxidise or burn its carbon, and we get its oxidised hydrogen in the form of water, and its oxidised carbon in the form of carbonic gas. When a candle is burnt with a sufficient amount of air, so as thoroughly to burn its constituents, we get nothing but these two products. Here is a bottle in which a candle has burned; the sides of the vessel are covered with moisture which has been formed in the burning, and on pouring some lime-water into the bottle, and shaking it up, it is converted into a mixture of chalk and water, by the carbonic gas which has been formed in the bottle by the combustion of the carbon of the candle. When, however, there is not enough air or oxygen to combine with both the carbon and the hydrogen of the burning candle, one of them must, in familiar language, “go to the wall,” and it is the carbon which does so. The hydrogen is burnt first, the oxygen having a preference for it, and the candle deposits its carbon in the form of soot. Now, this is an illustration of the way in which nearly all the varieties of charcoal are made. The materials are burnt with an insufficient supply of air—enough to burn the hydrogen and not

the carbon—and accordingly the carbon is deposited. Those large masses of coke which you see behind the locomotive engines are obtained in a similar manner. The coke consists of the carbon of the coal, the hydrogen being burnt away in the process of manufacture. In the same way, charcoal is got from wood by burning off the hydrogen and leaving the carbon unburnt; but there is altogether a different method by which the carbon may be separated from the hydrogen, and I mentioned it in my last lecture. Coal gas, you know, although perfectly transparent, contains black carbon, and when this coal gas is burnt with an insufficient supply of air we get soot by our old process (I call it *old* because of my having already spoken of it); but if, instead of burning the coal gas in that way, we make it very hot, under such circumstances that, through the exclusion of air, neither the carbon nor the hydrogen gets burnt, these constituents are separated from each other. Here is the tube containing the white porcelain, which, during the last lecture, we subjected to a strong heat while the coal gas was passing through it. The blackening of this white porcelain indicates that the carbon of the coal gas has been separated from the hydrogen, and the separation occurred, in this case, not from the effect of imperfect burning, but through the application of a strong heat. This, then, is another mode in which carbon may be obtained from its combinations. That large piece of carbon in front of you is called *gas carbon*, and it was made in the same way as that in the tube—by subjecting ordinary coal gas to a sufficiently high temperature. That carbon ought to have remained in the coal gas, but it was separated from it, and lined the interior of the vessel when the hydrogen passed on and left it.

Having spoken of the different ways in which carbon may be separated, I will just call your attention to an experiment which shows the actual production of it. I have here a small platinum dish, in which I have placed some substances capable of being burnt; these are nothing but nuts, kernels of fruit, acorns, and so on. If I simply burn them, they will all go away, and nothing will be left of them; but if, before making them hot in the dish, I take the precaution to cover them with sand, so that they get a very small supply of air, then they will burn imperfectly, and at the end of the lecture we shall have a residue in the form of charcoal. I am applying a good strong heat, and, in a little while, the hydrogen gas will escape from the top of the sand, and there ignite. You will see the hydrogen and a portion of the carbon burning, but the great mass of the carbon will remain behind, and we shall find it at the close of the lecture much in the same form as you see these nuts and kernels in this glass, converted into

charcoal. [Later in the lecture the hydrogen driven off by the heat from the contents of the platinum dish was observed to be burning on the surface of the sand].

So much for the way in which carbon is obtained; now for its properties. You will recollect that in the last lecture I called your attention to its very remarkable effects in absorbing gas. When you take a piece of charcoal into your hand, you not only have the carbon there, but you have also a large quantity of air or gas condensed in the pores of that carbon. In our last lecture, by means of an experiment with the air-pump, I showed you the charcoal giving up the air which had been contained in its pores. That was an illustration of the mode of extracting the air from the charcoal. Now I want to shew you the way in which we can get air *into* the charcoal. In this case, the air we will take is ammonia. I performed the experiment during the last lecture, and I will now repeat it. You see that the charcoal is gradually absorbing the ammonia gas, and, as it does so, the mercury rapidly rises.

There are some other curious properties of this charcoal to which I briefly alluded in my last lecture, and about which I wish now to make some further remarks. You will recollect my telling you that the gases given off by the partridge, undergoing the change called putrefaction, are absorbed into the charcoal, but they are something more than absorbed—they are *destroyed*. They are slowly burnt or oxidised—for you will remember that burning is another word for oxidation. The charcoal absorbs not only the gases given off by the partridge, but also these atmospheric gases, and when these come into contact with the gases given off by the partridge, which are, particularly, sulphuretted hydrogen and ammonia, they destroy them by oxidation. Now, this sulphuretted hydrogen gas which is emitted by putrefaction, has an exceedingly objectionable smell, and this smell affords one of the most delicate means of recognising its presence; but, fortunately, there are other ways of detecting it. It has the property of affecting certain metals, and when we want to ascertain whether this gas is present, we are not obliged to resort to the unpleasant method of smelling it. In this glass jar I have some paper which has been prepared with a metallic solution, and I will cause a current of sulphuretted hydrogen gas to pass through the tube into the jar or cylinder, and you will notice, I think, in the course of a little while, that our test paper inside the cylinder, indicates to us the presence of the gas, just as effectively as its smell would do, if we put our noses to the vessel. You see that the letters gradually come out on the test paper; they have now become perfectly visible. Thus we are able to recognise

this gas, not only by its smell, but by its action on the paper. I have here a tube which brings me a current of ordinary air, worked from a bellows below. This current bubbles up through a solution containing sulphuretted hydrogen, and, in so doing, it takes some of the sulphuretted hydrogen with it; it then goes into this glass vessel, when the sulphuretted hydrogen affects our test paper, and the air escapes from the top of the jar. If it escaped direct into the theatre, the sulphuretted hydrogen would be smelt by you; but I place over the top of the jar some pieces of wood charcoal, which absorb the sulphuretted hydrogen, and destroy its smell. We will now try the action of this gas on another kind of test paper, and here the effects will be somewhat similar to those produced in the last experiment, only, in this case, I have no letters written upon the paper. We will pass the gas through this other cylinder containing test paper, and you will see what effect it has there. In this case, the paper, instead of being written over with letters formed by a test solution, has been steeped in different solutions, and accordingly a very much larger quantity of gas is necessary to colour the whole of the surface. You see the paper is now becoming coloured; first we have the action of the gas upon a salt of lead, as shown by the production of a black mark. As the gas rises higher and higher, you see it begins to effect the next solution on the paper, and in this case, instead of a black stain, we get an orange one, and I daresay, after a little while, another colour will be developed at the top. I may call your attention to the bottom of the paper becoming yellow. The colour at the top is now appearing, and at the risk even of getting a slight smell from unabsorbed sulphuretted hydrogen, we will allow the action to go on to the full extent.

I want now to illustrate to you the mode in which charcoal arrests the flow of this gas, and for this purpose I will here take some small glass cylinders, containing metallic solutions upon which sulphuretted hydrogen will act, and I am going to blow through these solutions the same kind of sulphuretted air that I blew into these larger cylinders a few minutes ago; but I will arrange the experiment in such a way that before the air bubbles up into the water, I can either let it pass through the charcoal or not, at will. I am afraid that in this case I cannot keep back the odour, but I will endeavour to do so as much as I can. Here is one pair of cylinders, and the gas which passes through them must, first of all, go through the charcoal; but in order to pass through the other pair of cylinders it need not do so. We will first of all let it go through these cylinders where there is no charcoal, and then see what are its effects. The gas now enters our solutions, and im-

mediately produces, in the one case, a purple colouration, and, in the other, a decided orange. This is caused by the gas itself, before it has gone through the charcoal. Now we will let it come up from the other cylinders; in this case, it has first of all to go through the charcoal. Now you see that after it has gone through the charcoal it has no action whatever upon the solutions. It is now bubbling up through these solutions in the same way as it did through the others, but here we get no action. The charcoal completely arrests the passage of the gas—not only arrests it in the way of absorbing it, but entirely destroys it. In this instance, we are passing the two gases, sulphuretted hydrogen and oxygen, into the charcoal, and these immediately react upon one another in the pores of the charcoal. In order to show you that the want of effect does not arise from any exhaustion of our sulphuretted material, we will now let it ascend through these new vessels, without passing through the charcoal, and you see that the solution on my left very quickly becomes orange in colour, and that on my right becomes purple. Thus, the want of action was not due to a deficient supply of sulphuretted gas, but it was merely owing to the fact that, as the gas passed through this tube containing charcoal, it was so completely absorbed and oxidised that it could not, in any way, affect the solution through which it afterwards bubbled.

With regard to the action of charcoal upon liquids, you will remember that, on the last occasion, we had two long columns through which we filtered a red and a blue liquid, both of which had their colours completely taken out. I ought to call your attention to some of the practical applications of this property of charcoal. Here are some specimens of Madeira, Demarara, and beet-root sugar, which have been kindly supplied to me by Mr. Duncan, of Whitechapel. The whole of the colour of these liquids has been taken out by filtering them through charcoal, in the way that you saw me filter the liquids the other day. After the first filtration, you get a liquid which has a distinctly brown tinge when compared with the white sugar, but after a second filtration through charcoal the liquid, on evaporation, yields pure white sugar.

Now, in all those changes to which I have called your attention, the charcoal itself remains the same. We have next to consider more distinctly the changes which charcoal undergoes, apart from those which it is capable of producing upon other bodies.

Charcoal is a very stable body. It lasts for ages and ages, and is not liable to decay. In the British Museum there are specimens of charcoal which were charred at Pompeii, and which have stood for centuries. It is one of

the most stable bodies we know; nevertheless, it is capable of being acted upon by strong chemical re-agents. I will take some of this substance, and act upon it by an acid. I must have my charcoal rather warm for this purpose, and now I let it fall into this strong chemical agent—nitric acid—and you see that, under these circumstances, the nitric acid acts upon the charcoal very violently. The charcoal, which is a very permanent body, and not affected by most chemical agents at ordinary temperatures, is acted upon by this nitric acid, and to such an extent that it not unfrequently takes fire, as in this experiment.

The most important, however, of the changes which it is capable of undergoing, is one to which I have already, on one or two occasions, directed your attention, namely, its change into carbonic gas, and now I am going once more to show you this change, but in a somewhat different form. I have here a piece of easily igniting charcoal enclosed in this tube; I just set fire to it at one end, and place it alight in the tube, through which I pass a current of oxygen gas. You observe that the charcoal is now burning with very great brilliancy in the oxygen gas. The charcoal is converted into a gas, and as it bubbles up through our lime-water it changes the lime-water into a mixture of chalk and water. In this way I cause the complete disappearance of the charcoal, it being converted entirely into the carbonic gas, which I am arresting by means of the lime-water. Here you see the large amount of chalk which I have produced by the conversion of our charcoal into carbonic gas, and the combination of that carbonic gas with the lime contained in the lime-water.

Now I will illustrate the conversion of charcoal into carbonic gas in one or two other ways. I will bring before you another mode by which we may burn this substance in oxygen. You observe I am burning some in a globe full of this gas, and it is ceasing to be charcoal, and is being changed into carbonic gas; and here you have an illustration of the most remarkable, or, at any rate, the most important of the changes which charcoal is capable of undergoing. Lastly, I will show you one more experiment illustrating the mode in which we can burn charcoal in oxygen. [A stream of oxygen was made to impinge upon some pieces of incandescent charcoal lying at the bottom of a glass beaker]. You see the very brilliant manner in which the charcoal burns in our current of oxygen gas.

We have, then, arrived at this point—that charcoal is a substance which burns very readily, and, by its combustion, is converted into carbonic gas.

(To be continued).

CORRESPONDENCE.

ON PHOSPHORUS IN IRON AND STEEL.

To the Editor of the Chemical News.

Sir,—In the CHEMICAL NEWS of January 29th, page 58, is an abstract of a paper by Dr. B. H. Paul, read at the Chemical Society, on "The Connection between the Mechanical Properties of Malleable Iron and Steel, and the Amount of Phosphorus they contain," and a report of the discussion which followed it. Judging from these, it appears that the very serious fallacy upon which Dr. Paul's conclusions were based was not detected by any of the distinguished chemists who were present and took part in the discussion.

The fallacy I refer to is that of judging of the quality of steel by Mr. Kirkaldy's tests of tensile strain, &c. Had Dr. Paul carried his researches further by examining in the same manner the relative tenacity of several samples of iron (or of steel containing but little carbon), which varied only in the quantity of phosphorus they contained, he would, probably, come to a much stronger conclusion, and have asserted, as some continental chemists have done, that phosphorus, up to 0.50 per cent, improves the quality of steel. The action of phosphorus on iron and steel is to increase their hardness and their brittleness when cold, and at the same time—within certain limits—it increases their tenacity, provided they are not already highly charged with other hardening constituents. I refer here only to the tenacity as measured by a *direct and gradually applied longitudinal or axial strain*.

If the iron or steel were required for tie rods, to be subject only to a strictly axial pull, that should never occur suddenly, and that should be quite unaccompanied by vibrations, Dr. Paul's conclusion that 0.24 per cent of phosphorus would be quite a harmless quantity, and Dr. Miller's statement that 0.298 per cent of phosphorus in steel iron "is obviously not such as to injure the quality" would be quite correct, for steel iron for such a purpose would be improved by that amount of phosphorus. It is, however, quite obvious that such a combination of conditions is practically impossible.

When we consider the work to be done by the edge of a chisel, a hatchet, a sword, a graver, or a turning tool, by the teeth of a file, or a saw, or the duty of edged tools generally, it is obvious that the power of resisting a sudden, a vibratory, and a transverse shock is the property most demanded. Now this is just the property which phosphorus tends to destroy. An excess of combined carbon has a similar effect, and it is impossible to obtain hardness without a sacrifice of toughness, but this sacrifice is much greater when hardening is obtained by phosphorus than when it is conferred in an equal degree by carbon.

I have never tried the experiment, but have very little doubt that a factitious steel might be made in which phosphorus should replace (in a lower proportion) the carbon of ordinary steel, and that such a factitious steel would take a very respectable position if tried by Mr. Kirkaldy's direct tensile test *only*. It would, however, be practically useless on account of its incurable brittleness. This brittleness would be indicated by Mr. Kirkaldy's *extension test*, but not to its full practical value on account of the gradual application of the strain and the absence of vibration.

Phosphorus has another prejudicial effect upon steel, which is not in the slightest degree indicated by either the tenacity or the extension tests. I refer to the intractability of the hardness which it confers. The hardness which carbon gives to steel possesses the characteristic and invaluable susceptibility of annealing and tempering; it may, within certain limits, be modified through an infinite series of gradations, and the steel thereby may be worked by steel, and adapted to the multifarious uses for

which it is required. The hardness conferred by phosphorus is practically a constant quantity at a given temperature. It disappears when the iron or steel is heated, and returns on cooling; but, as far as I have at present been able to learn, the rate of cooling does not sensibly modify it.

I make the above remarks with all due deference to Dr. Miller and the other eminent chemists whose opinions on this subject I have ventured to controvert, but, as my daily work is amidst the volcanic belchings of Bessemer converters, the thumping, crashing, and earthquaking of steam-hammers, &c., I have opportunities of comparing the results of chemical analysis with the verdicts of practical trials, which are quite unattainable in any college laboratory. With all these advantages, I find the solution of such questions as the action of small quantities of phosphorus so very difficult, that I make the above remarks with some diffidence as a crude exposition of approximate knowledge.

As regards the Heaton process, which has led to this discussion, I may state that I have visited Langley Mill, and examined the work done there, on behalf of the company by whom I am employed, and although it is not my intention to here express any opinion as to the general merits or demerits of the process, I cannot refrain from saying that it appears to me that Mr. Heaton is somewhat misled on this particular subject of phosphorus—that he is not doing justice to himself in making his early trials chiefly with inferior pigs containing excessive quantities of phosphorus. Had he directed his first efforts to the production of the best quality of steel from the best quality of pigs, rather than endeavouring to compete with the Bessemer process in the race of cheapness, I believe that his results would have been more satisfactory and conclusive.

The difference in value between the best and the worst qualities of British pig-iron is about £3 per ton, while the difference in value between the best qualities of cast-steel and an ordinary Bessemer steel rail, is quite ten times that amount; and I suspect that the conversion of the best pigs to steel of a given hardness would be effected with a smaller quantity of nitrate than is required for those of inferior quality. The worst sample of Heaton steel that I have analysed contains 0.24 per cent of phosphorus, the best only 0.05 per cent. They differ widely in other respects. The first sample I saw made from an inferior pig-iron from the neighbourhood of Mr. Heaton's works, and which I had already analysed; the second was, I believe, made from a pig of very superior quality to this. The difference in value between the two products is many times greater than that between the raw materials.

Since writing the above I have received the current number of the CHEMICAL NEWS, and there read an extract from *Engineering* on this subject. You wisely disclaim any endorsement of the views there expressed. I had no intention of expressing in this letter any general opinion on the merits of Mr. Heaton's process, but this extract contains two statements which are so outrageous, that I cannot, as a lover of truth, abstain from flatly contradicting them. The first is that "*The Heaton process never produced an ounce of steel or anything resembling it.*" I have examined six samples of the product which I saw made from a pig-iron I had already analysed. The analyses of all these samples proved them to be steel, and the comparison between their composition and that of the pig-iron proved that the process was one of true conversion.

The next statement referred to is that "the furnace in which Mr. Heaton professes to melt steel at a cost for coal of 5s. per ton was never built." I was at Langley Mill on the 13th of January last, and there saw and carefully examined the furnace referred to. It was a furnace that had seen some service as proved by the vitrified surface of the flues and fettling. I speak only of the *existence* of the furnace, not of its action, as I have not seen it in operation.

I am glad to see that this subject is to be taken up in the pages of the CHEMICAL NEWS which have never been used for the purposes of trading puffs or trade animosities, or that editorial pandering to advertisers in which some of the so-called scientific publications of the day have so largely indulged.

This nitrate of soda process involves some obscure chemical reactions of great scientific interest, irrespective of its commercial objects, and a description of the chemical questions it opens, in a journal which has uniformly been devoted to the faithful service of science, cannot fail to be of considerable value.—I am, &c.,

W. MATTIEU WILLIAMS.

The Laboratory, Sir John Brown and Co., Sheffield,
February 13, 1869.

DR. WALLACE'S LECTURE ON THE CHEMISTRY OF SUGAR REFINING.

To the Editor of the Chemical News.

SIR,—The absence of Dr. Wallace when the above lecture was read is much to be regretted. No doubt many were present who, like myself, would have been glad to have asked some questions of the author, and I think it a pity that, under the circumstances, the lecture was not postponed.

Dr. Wallace, in his remarks upon the bleaching action of ozone upon sugar, expresses a fear that this powerful agent will be found to destroy too much of the sugar to permit of its successful use. I am anxious if possible to allay this fear by stating that my researches upon this subject have convinced me that ozone, although it acts powerfully upon caramel, has, in the way in which I apply it, no action at all upon sugar. I found in one experiment that the juice of beet-roots grown in London, which marked only 6° Baumé, was perfectly crystallised when kept at a temperature of 160° F. and submitted at this temperature to the action of a current of ozonised air. Anyone conversant with the difficulty of effecting the crystallisation of weak cane or beet juice, especially when operating on small quantities, will perceive that in this case the sugar would not have crystallised if it had been injuriously affected by the ozone.

As I remarked in the course of the discussion on Dr. Wallace's lecture, I do not think the ozone process is as yet sufficiently advanced to justify me in speaking with certainty upon it, but the few statements which I have made in regard to it are founded on careful experiments, and may be relied upon. In the meantime I cannot help remarking that none but those who have themselves experimented upon the process, can form any satisfactory opinion upon it, or have any right to comment on its merits or demerits.—I am, &c.,

EDWARD BEANES.

Cordwalles, Maidenhead, Berks,
Feb. 17, 1869.

MISCELLANEOUS.

Glasgow Philosophical Society (Chemical Section).—A meeting was held in the Society's rooms, Andersonian Buildings, on Monday evening, the 15th inst., at eight o'clock, E. C. C. Stanford, Esq., in the chair. One new member was admitted, and one candidate proposed. Mr. Gavin Chapman read a paper "On the Best Method of Utilising Sewage," which we hope to be able to give fully in an early issue.

A Curious Vocation for a Scientific Society.—Amongst the objects for which The Victoria Institute or Philosophical Society of Great Britain has been formed is, "to give greater force and influence to proofs and arguments which might be regarded as comparatively

weak and valueless, or be little known if put forward merely by individuals."

The Heaton Steel and Iron Process.—In our last number we gave a very short abstract of an article in *Engineering*. The assertions therein made appeared so bold and expressed in such strong language, that we took the precaution of prefacing our abstract in such a manner as not to mislead the readers of this paper into supposing that they received our sanction. Last week's *Engineer* contains a long letter from Mr. John Heaton, in which he refutes in the most positive manner the various statements concerning the Heaton process which have from time to time appeared in *Engineering*, and we have since been informed that two actions have been commenced against the editor of *Engineering*, so as to bring the whole matter before a legal tribunal.

Abstract of the Petroleum Acts of 1862 and 1868.—(1). The object of these acts is the better protection of life and property from fire. (2). The acts only relate, (a) to oils or spirits obtained from the mineral kingdom, indeed (b) only to such of these liquids as, at any temperature below 100° F., give off inflammable vapour sufficiently fast to afford a distinct flash of flame on the approach of a light. (3). The mineral oils or spirits which thus kindle below 100° may only be sold (wholesale or retail) when the containing vessel bears the following label:—"Great care must be taken in bringing any light near to the contents of this vessel, as they give off an inflammable vapour at a temperature of less than 100° of Fahrenheit's thermometer." (4). Dealers in these labelled liquids may, without restriction, store them in any place that is more than fifty yards from a dwelling-house or warehouse. Before they may be kept *within* that distance either in large or small quantities (except for private use) the dealer must obtain a licence from one of the following authorities:—The Court or Council of a Mayor and Aldermen; the Metropolitan Board of Works; Local Improvement Commissioners. (In Scotland) any Town Council or Police Commissioners. (In any harbour) the harbour authority. (In other places in England) the Justices of Petty Sessions. (In other places in Scotland) any two Justices of the Peace for the County. (5). Inspectors of Weights and Measures are empowered to inspect stocks. Offenders under the act are liable to be fined.

NOTES AND QUERIES.

Bavarian Beer.—Liebig states that 1460 quarts of best Bavarian beer contain exactly the nourishment of a two-and-a-half pound loaf of bread.

Oreïde.—Composition of the alloy termed "oreïde":—Copper, 79.7 parts; zinc, 83.05; nickel, 6.09; iron, 0.28; tin, 0.09. This alloy, the two last constituents of which are purely accidental, resembles gold, and is used at Paris for imitating jewellery. A white alloy, very much resembling silver, consists of 69.8 parts of copper, 19.8 of nickel, 5.5 of zinc, and 4.7 of cadmium; it is a very hard alloy, which takes a beautiful polish.

MEETINGS FOR THE WEEK.

MONDAY, 22nd.—Medical, 8.
London Institution, 6.
TUESDAY, 23rd.—Royal Institution, 3. Rev. F. W. Farrar, "On Comparative Philology."
WEDNESDAY, 24th.—Geological, 8.
Society of Arts, 8.
THURSDAY, 25th.—Royal Institution, 3. Dr. Harley, "On Respiration."
London Institution, 6.
Royal, 8.30.
Zoological, 8.30.
FRIDAY, 26th.—Royal Institution, 8. Dr. Bridges, "On Civilisation and Health."
Quekett Club, 8.
SATURDAY, 27th.—Royal Institution, 3. Dr. Odling, F.R.S., "On Hydrogen and its Analogues."

* * Owing to press of matter, our answers to correspondents are unavoidably postponed till next week.

THE CHEMICAL NEWS.

VOL. XIX. No. 482.

ON THE ACTION OF CARBOLIC ACID AS A THERAPEUTIC AGENT.*

By JOSEPH HIRSCH, Ph.D.

THE interest and importance of carbolic acid at the present day as a therapeutic agent were too tempting an invitation to experiment somewhat with this substance to be resisted, and although the experiments were so simple as to be hardly noteworthy, they still serve so far to illustrate the *modus operandi* of the acid, that I venture to recommend its trial in the treatment of some diseases in which, until now, the so-called expectative treatment, *i.e.*, no treatment at all, except good nourishment, has been pursued as the only useful one. The starting point of these experiments was the power of the acid to coagulate albumen, which it does in virtue of its nature as an acid by entering into a union with the albumen. Reflecting upon the therapeutic action of carbolic acid, one is naturally led to connect it with its influence upon albumen, because this reaction is a very marked one, while albumen plays the prime part in the animal organism, being present in all those substances which supply the entire body or individual parts of it with the materials requisite for nutrition and the renovation of effete matters. It is the main constituent of the blood, the lymph, the chyle, and all serous fluids contained in the cellular tissue—in fact, all animal tissues are surrounded by an albuminous fluid, and all changes in the blood proceed from the albumen. For the purpose of my experiments I therefore took three series of solutions of albumen. The one was chemically pure albumen, prepared from white of egg in the well-known manner; the second was white of egg in its natural state and also diluted to nearly one-half, *i.e.*, the concentration in which it occurs in the blood; the third series were solutions of blood albumen, or serum, taken from cattle, sheep, and the pig, deprived as nearly as possible from the red corpuscles, so as to show the influence of the salts contained in the blood upon the behaviour of the albumen towards carbolic acid.

At the same time I prepared solutions of carbolic acid of different strength, with which to test the manner and extent of coagulation of the albumen. I dissolved the acid in glycerine, starting with solutions of 90 per cent of acid, each subsequent solution containing 10 per cent less of the acid, while I carried the fractions of 1 per cent down to 0.01 per cent, having nine solutions containing less than 1 per cent of carbolic acid, and eleven solutions containing 1 per cent and over.

The series of solutions of pure albumen were more or less congealed during these experiments, even before they were coagulated by the acid. The coagula were less firm than those of the other solutions produced by acid of the same strength, of which even the most concentrated penetrated the entire mass of albumen much quicker than any of the other albuminous solutions.

The blood albumen also coagulated slightly faster than that of egg, but less so than the first mentioned series. Here the salts then seemed to act as diluents, rendering the coagulum more porous. This difference in the time of coagulation of the various solutions of the same strength was the main difference observable. In those of different concentration it appeared, in addition, that in the more diluted solutions the coagulum grew in streaks downward,

while in the concentrated solutions it progressed evenly over the entire surface of the albumen. In this case the solidification proceeded exceedingly slow.

The coagula produced by the most concentrated solutions were the most solid, but the least voluminous. The acid was added slowly to prevent a disturbance of the solutions of albumen, upon which the former floated, extending thus its action gradually downward. This took place very slowly with the dense solutions, the coagula of which appeared to be almost impenetrable to the acid, causing the substratum of liquid albumen to remain unchanged for a great length of time. The more diluted solutions produced a softer coagulum, easier penetrated by the excess of carbolic acid, while with the greatest dilutions the albumen coagulated in fibres, until finally only a turbidity was the result of the mixture.

The fibrous coagula were washed upon a filter with remarkable facility, while the coagula produced by greater dilutions partly passed through the filter, which, though finally, was clogged. These clogged filters I fastened to one end of glass tubes perfectly tight, of which I assured myself by keeping the tube filled partly with water for twenty-four hours. Testing, then, this primitive endosmotic apparatus with a solution of sodic chloride alongside of another one of the same size, constructed with bladder, I found the albumen apparatus to work somewhat faster than the other; but in consideration of the fact that the paper filter could not be drawn as tightly over the opening of the tube as the bladder for fear of tearing it, the quicker permeation of the filter may be ascribed to its greater surface. All the coagula placed under water at a temperature of about 80° F., for over three months remained apparently unchanged, although some of them during all this time were mixed with either one of the following substances, in which putrefaction had set in before their addition to the coagula. These substances were casein, blood, brewers' yeast, and leaven. There seems, then, to have remained a sufficient quantity of carbolic acid within the pores of the coagulated albumen to arrest even the decomposition of the substances added.

With these preliminary experiments, I compared the effect of carbolic acid upon the system; the application of a concentrated solution of the acid to the skin produced, in a short time, a white opaque spot of horny aspect, which soon peeled off. The same spot produced on a highly sensitive part of the epidermis, as on the tongue, at once loses its sensitiveness; and a feeling as of the presence of a foreign body as coating is experienced.

In both cases the opacity of the spot, by its resemblance to the opaque coagulated albumen, at once reveals the nature of the change produced by the acid. "The albumen of the blood, which through the numberless ramifications of the blood-vessels is carried to the skin for its nourishment, becomes coagulated." In this state it is solid, precluding the motion of liquids of its own kind within its substance, and with this motion nourishment and life. As lifeless, dead matter, the skin must necessarily peel off; it must, with the loss of vitality, be deprived of all the prerogatives of life, of feeling, as noticed above. Taking the coagulation of albumen as the immediate effect of applying carbolic acid to any organic substance, we shall find no difficulty in explaining the suspension of life without its complete extinction in the microscopical beings known as contagion. They contain, no matter whether they are animalculæ or minute plants—a question not yet definitely settled—albumen; blood albumen in the former case, vegetable albumen in the second.

Here the carbolic acid, coagulating the albumen on the surface of the corpuscle, forms an insoluble envelope, impenetrable to air and to further quantities of carbolic acid, which in this manner forms an obstacle to the entrance of greater quantities of itself into the interior of the small body. This then retains in its centre a minute portion unchanged, full of life, capable of increase under favourable circumstances, and protected from external

* Communicated by the Author, having been read before the Chicago College of Pharmacy.

influences by its coating of coagulated albumen. Such a corpuscle acted upon by carbolic acid may be represented by an egg exposed to boiling water for a few seconds. The coagulating influence of heat affects the superficial layer of albumen, which still encloses the rest of the egg in its raw state. All substances or processes producing the same coagulating effect upon albumen do in reality exert the same destructive influence upon contagion and miasma, but none possess other necessary properties qualifying them for this purpose as well as carbolic acid. Heat, which coagulates albumen, has been used successfully in the disinfection of places and clothing infested with the poison of cholera, small-pox, yellow fever, &c.; but while we can turn high pressure or even superheated steam into a room, a ship, &c., we cannot subject a cholera patient, or an animal infected with the cattle plague, to so high a temperature as to destroy the poison lurking within them; and if in diluted carbolic acid we have a remedy, which with such coagulation will destroy the activity of contagion without interfering with the process of life in the patient, we have found a desideratum which is at once a boon to mankind and a victory of science important beyond comparison. Other chemicals, as the mineral acids, their salts which coagulate albumen, also destroy contagion; but their destructive influence upon the animal organism in that state of concentration in which they coagulate albumen precludes their use in contagious diseases under the same circumstances, for similar reasons, under which superheated steam is unavailable.

On the other hand, carbolic acid in great dilution exerts a barely perceptible influence upon the vital process of the larger animals, while its power of destroying sporules is almost equal to that of the concentrated acid.

This apparent anomaly is easily explained on comparing its action to the parallel coagulation of a highly diluted solution of albumen by one similarly diluted of the acid. The diluted solution is as completely coagulated as a dense one; but the immense dilution places the particles of albumen at such great distances from each other that they can no more form a coherent mass after coagulation, but remain separately suspended in the liquid, rendering it opaque and milky in appearance. This liquid, although charged with insoluble albumen, will filter through paper, as also through the pores of all the tissues of the animal organism. The dilute carbolic acid introduced into the system will, in the same manner, coagulate the albumen and sporules it meets upon its passage in such subdivision that the coagulum can no longer form a dense coherent coating, as is the case during the application of the concentrated acid, while the minute particles of this coagulum, after filtering through the animal tissue, do no longer oppose an obstacle to the free passage of greater quantities of the carbolic acid or of the vital fluids.

On the other hand, the sporules, constituting the contagion, are so minute themselves that the limited sphere of action of the diluted acid still embraces a complete sporule, or a number of them, which thus have their vitality suspended as completely as by the concentrated acid.

The great divisibility, respective volatility of the acid, prevents its complete neutralisation by the albumen of the larger organism to the exclusion of that of the sporules, the albumen being a base of no great energy, especially if linked to as faint an acid as carbolic. Nevertheless for a complete curative effect the dose must be repeated, as the acid owns, in common with all other drugs, the property that the limit of its sphere of action is proportionate to its amount. The manner of action of the acid as shown illustrates the difference of its operation as a disinfectant from other substances used for that purpose, which are mostly oxidising agents acting upon the products of decomposition, like ammonia, hydric sulphide, &c., which are altogether out of the sphere of action of carbolic acid, because they are not capable of coagulation. They may partly be neutralised by the same, but being volatile, it

is not superior in this respect to the ordinary mineral acids.

The great reducing powers of carbolic acid recommend it for the detection of hydric peroxide, as has been proposed lately. The addition of the last-named substance to a mixture of aqueous carbolic acid and ferrous sulphate produces a permanent green colouration. Here the carbolic acid prevents the oxidation of the ferric protoxide by the hydric peroxide, which, without its presence, takes place.

That this reducing action is a prominent factor in its mode of destroying contagion, by preventing oxidation, which is synonymous with life, there is but little doubt. For the kindred processes, like fermentation, have been found to be true processes of oxidation, and we are enabled to prevent or stop fermentation by various other reducing agents—for instance, the hyposulphites, the efficacy of which in various contagious diseases has also been well tested.

ON THE CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(ADAPTED TO A JUVENILE AUDITORY),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN,
(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, Esq., M.B., F.R.S.

(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE IV.

CARBONIC GAS, OR FIXED AIR.

(Continued from p. 94.)

HAVING considered the properties of charcoal somewhat minutely, I will next examine more particularly a substance to which I have already made very frequent reference, namely, carbonic gas, which is the product of the burning or oxidation of charcoal. What, then, are the properties of this carbonic gas?

First of all, with regard to the mode in which it is made. You will remember I made it just now by burning charcoal. That is one way; but another way is by starting, not from charcoal, but from marble. If we take some marble and heat it very strongly, it gives off this carbonic gas; but instead of acting upon it by heat we more commonly, as a matter of convenience, treat it with acids, and consequently we employ an apparatus of the kind which you have seen used for that purpose at previous lectures. Here I have such an apparatus, in which carbonic gas is being produced from marble, and from which I can obtain it in order to consider its properties minutely and *seriatim*. I first turn on our gas, and immediately we re-

* Reported verbatim, by permission of the Author, for this Journal.

cognise one of its characters, namely, that it has the property of combining with soluble lime, and of converting it into insoluble chalk. The next property of the gas which I shall show you is also one to which I have before alluded—its property of extinguishing flame. Here is a large glass jar which has been filled with carbonic gas from an apparatus beneath this theatre, similar to the one on the table, but which is on a larger scale, and supplies us more conveniently with the gas. We will see whether this glass jar is full of the gas. [A lighted taper was extinguished immediately upon being introduced within the brim of the jar.] Yes, it is quite filled. You see, directly I put the taper in it is extinguished. If I take some larger substance than this—this burning tow, for instance—it also is completely extinguished. The second property of carbonic gas, then, is that of putting out flame.

I wish now to make you acquainted with some further properties of this gas, so I will first show you what its behaviour is under certain circumstances, and then I can remark upon it after you have seen the experiments. Here is a long tube filled with water, and having its open end immersed in the same fluid. I will raise the mouth of the tube a little, and fill it to the label with carbonic gas; I take the tube and shake it up with the water, and then notice whether any effect is observable. I keep it closed firmly with my hand, and replace the mouth in water; on removing my hand you see that the liquid rises very considerably in the tube. This experiment, then, reveals to us the fact that carbonic gas is capable of being absorbed in water. It dissolves appreciably in water through this agitation, but it will dissolve to a much greater extent under pressure. The experiment is rather too long to allow me to show it to you as a lecture experiment, but I will point out to you its result. If I took a bottle of ordinary water, and applied this forcing syringe to it, I could inject into that water a large quantity of carbonic gas—a quantity, indeed, only limited by the strength of the bottle. I could go on forcing in the gas until I burst the bottle. Here is a bottle of soda-water which I have made by pumping carbonic gas into ordinary water, and, in fact, most of the soda-water ordinarily met with is made in this way. On removing the pressure from the surface of the liquid, the gas escapes, and this gas which is given off is nothing more than that which is obtained from marble or burning charcoal, and it has all the properties which I have mentioned as belonging to carbonic gas. You will remember that the gas from marble has the property of extinguishing flame and of making lime-water turbid. I will collect some of the gas evolved from soda-water, and I will then show you its properties. Here, for example, is

a bottle of soda-water; I open it in the usual way, but cautiously, so that the gas may not escape very violently. Having removed the cork, I let the gas from the soda-water play upon the flame of a candle, and you see it at once puts it out. Now let me show you the amount of gas which we can collect from a bottle of soda-water. I take a cylinder of water, close it with a glass plate, and invert in a pneumatic trough. Here is a bottle of soda-water, into which I have inserted a tap; this I turn on, and allow the escaping carbonic gas to pass through a tube and bubble up through the water into the glass cylinder, and in this way I can collect a considerable quantity of this gas. Now, let me show you that this soda-water gas is capable of giving a precipitate with lime-water. I take another bottle of it, but instead of using a screw-tap, which is not necessary for the present experiment, I remove the cork in the ordinary way, and quickly insert in its stead a cork fitted with a glass tube, which has been placed in a hole bored through the cork. The gas which escapes from the liquid in the bottle passes through this tube, and we now have the gas bubbling up through the lime-water test, and converting it into chalk and water, just as did the gas we obtained in other ways.

This gas has another very important property; instead of using the ordinary strong lime-water I will take some far more dilute. I have put some of the strong lime-water into this jar, and now I will add to it a considerable quantity of distilled water. Here, then, is our diluted lime-water, and I now pass a current of carbonic gas rather quickly through this apparatus. The first effect in this case, as on previous occasions, is that we get our deposit of chalk, but I want you to watch the experiment, for you will find that the chalk which at first is apparent, entirely disappears after a little time. I can show you the same result in the case of soda-water. I will pour some lime-water into another of these glasses, and then empty into it a bottle of soda-water, and watch the result. You observe that the first effect is that the lime is converted into chalk, of which we obtain a considerable amount. Now I will add some more soda-water, and you will observe that the liquid becomes perfectly clear. Here, again, is another liquid in which chalk has been formed by the action of carbonic gas upon lime water. It is perfectly opaque, but if we add a little soda-water to it, the precipitate of chalk will eventually disappear. We have thus learned a fact entirely new to us—namely, that although, when we add carbonic gas to lime-water, we get insoluble chalk, yet if we continue to pass the carbonic gas through the chalky liquid, the whole of that chalk entirely dissolves after a certain length of time; so while chalk is insoluble in pure water, it is

perfectly soluble in water containing carbonic gas. Indeed, all our ordinary waters hold chalk in solution, held dissolved by means of the gas obtainable from charcoal.

Another fact with regard to the solubility of this gas in water is that, when we remove the pressure—that is to say, take the cork out of the soda-water bottle—we allow the escape of a considerable quantity of this gas, but we do not expel the whole of it. In order to do this we shall find it advisable to boil the water. In this flask we will boil some water containing carbonic gas. This is a bottle of soda-water from which we allowed all the gas to escape which would do so upon merely uncorking the bottle, and as the escape has gone on to that point, we will allow the water to boil in the flask, or rather we will apply heat to it, and you will find that the heat will drive off more of the gas, which, in the course of a minute or two, we shall have collected in a cylinder. I will allow it to heat rather rapidly, and you will see the gas bubbling up through the cylinder. You observe we are now driving off more of the gas by the application of heat. Now, just bear in mind what would happen if I took the cylinder and boiled the liquid containing the chalk, which was dissolved by the presence of carbonic gas in the water. The heat would drive off the excess of carbonic gas, just as we are forcing the carbonic gas off from the liquid in the flask. We ought consequently to have our precipitate of chalk manifesting itself in the solution; this is just what happens. We will boil that liquid, and you will see that when this is done it will deposit chalk on giving up its carbonic gas. [After an interval]—I will now ask you again to observe this liquid. You remember it was at first perfectly clear, but on boiling it has become opaque. The chalk which was held in solution by the carbonic gas has been precipitated as the gas became driven off by the heat. That deposit is nothing but boiler fur. Now, this [exhibiting a large broken kettle considerably furred inside] is not a very elegant article to bring before a Royal Institution audience; this kettle contains a large quantity of *fur*, consisting of the chalk which was dissolved in the water by the carbonic gas, and deposited on the inner surface of the kettle, when the carbonic gas was driven from the water by boiling. Chemically, this deposit is nothing more than marble. If I take a portion of this boiler fur and act upon it by heat, carbonic gas will be evolved, or, if I add acid, it effervesces very readily, and gives rise to the same gas.

We have now collected a rather large quantity of gas by boiling the soda-water. We will just ascertain whether this gas possesses the property of extinguishing flame. [A light was lowered into the jar containing the collected gas]. You

see from this experiment that it *does*; thus, partly by merely removing the cork of the soda-water bottle, and collecting the escaping gas, partly by boiling the liquid, you see that we have procured a large quantity of carbonic gas, of which I will now exhibit to you some other remarkable properties. I have here a bottle containing gas; I take out the stopper, and still we have the bottle of gas. I will test its presence in the usual way, by introducing a lighted taper; the taper is at once extinguished, and though the bottle might be left open for a considerable length of time, still the gas would remain and the taper would be put out. Now, what does that suggest to us? Let me try whether I can perform a somewhat similar experiment with a glass of water. I will take this bottle containing a solution of salt. It is nothing more than common salt dissolved in water, and it is coloured so as to make it visible. Now I lower this bottle into a jar of colourless water: I do it carefully, so that the solution of salt mixes with the water as little as possible, and you see that the coloured solution of salt remains in the bottle, although it is at the bottom of the jar of water. It does not mix with the water to any appreciable extent, because the solution of salt is really heavier than the water above it; and just in the same way this carbonic gas remains in the open bottle, undergoing no very appreciable amount of mixing with the surrounding air, because it is really heavier than the air. I once more introduce the taper, and you see that the bottle still contains the gas, for the taper is extinguished. Now I will reverse the experiment, and take this glass bottle containing a liquid lighter than water—spirit of wine—coloured red. I will lower it into the jar of water just as I introduced the solution of salt,—but observe the difference of the result! See how the red liquid is streaming up to the top of the jar of water, and the colourless water is pouring into the glass which contained the spirit. Our carbonic gas is, therefore, in the position of this solution of salt, and not in that of the spirit of wine. You see that, introducing in this way the coloured spirit into the jar of water, I obtain two perfectly distinct layers of liquid. The water is beneath, and the coloured spirit at the top; you see I can draw off some of the latter from the upper part of the vessel.

I can show you some very curious effects of the weight of this carbonic gas, and I have here an experiment arranged for that purpose. In this bottle are two separate gases—carbonic gas and oxygen—the oxygen being in the upper part. I pass this lighted taper rapidly through the oxygen into the carbonic gas, and the flame is immediately extinguished. I raise it into the oxygen, and you see how readily the taper bursts into a flame and how brilliantly it burns.

Thus, you perceive that this carbonic gas is not only heavier than atmospheric air, but it is also heavier than oxygen, which will float on it. [The taper was extinguished and re-kindled several times in succession by being plunged into the carbonic gas, and then rapidly raised into the stratum of oxygen in the upper part of the bottle.]

Now I will make use of some liquids to illustrate to you the effects of these differences of weight. In this jar I have merely some water coloured red in order that it may be distinct, and through this water I want to pour a heavy liquid, namely, a solution of common salt, coloured purple, and by pouring this carefully through the funnel, I shall, in a little while, get a layer of purple liquid at the bottom. There is always a certain amount of mixing, but it will be so little that you will easily recognise the two distinct layers—a purple layer of solution of common salt at the bottom, and a red layer of water on the top. I think those who are near will see that we have already obtained these. I am, in fact, pouring a heavy liquid through a lighter one, and just in the same way I can pour a heavy gas through a lighter one, either by means of a funnel, or by another method which I will presently explain to you. If I take a liquid which is much heavier than water, I can pour it into water and form a distinct layer without any funnel. Here is some colourless water, and into this I am about to pour a liquid which is much heavier than the solution of salt, and which may therefore be poured without the funnel. This heavy liquid is oil of vitriol, and you see that in this way we get the colourless water at the top, and a stream of oil of vitriol descending to the bottom, and there forming a shading of blue.

Now I want to illustrate the same point to you by means of experiments performed with carbonic gas. Here is a cylinder of this gas coloured brown, and I will pour some of it into this cylinder of air. You will see it pass through the funnel and reach the bottom of the cylinder. It takes some little time to descend, but I can already see it pouring down. The funnel is now full of the brown gas, and sufficient has descended into the cylinder to answer our purpose. I have thus poured down our heavy carbonic gas, which was coloured brown; but I will now show you that I can not only pour carbonic gas through the funnel, but through the air without a funnel, just as I did the oil of vitriol through the water. I take this bottle of carbonic gas, and let a little of it flow upon the candle, and so put it out. Now I will pour some into this bottle containing lime-water. You observe that the lime-water is perfectly clear; but I now remove the stopper from the bottle of gas, and pour some of it upon the lime-

water, and you see that we get an ample amount of gas. Let us try the weight of the gas in another way. Here is a pair of scales; you see that, at present, the counterpoise is a little too heavy, and goes down rather lower than the other side of the balance. I now open the bottle of gas and pour some of it carefully into the beaker attached to the scales, and the gas is so heavy that it actually turns the balance, and not only turns it, but keeps it down to a very considerable degree.

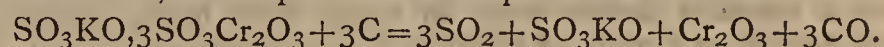
I will reserve for my next lecture some further illustrations of the extreme weight of carbonic gas.

NOTE ON

THE UTILISATION OF CHROME ALUM.

By M. F. JEAN.

THE manufacture of aniline green and violet, and of valerianic acid, gives abundant residues of chrome alum. These residues cannot be utilised as mordants, because, when calcined, they are insoluble in water, and therefore do not find a sufficient market, thereby considerably augmenting the net price of products prepared with bichromate of potash. Whilst endeavouring to turn these residues to account, I discovered that when chrome alum, previously mixed with three equivalents of carbon, is heated to redness, decomposition takes place as follows:—



If, on the other hand, chrome alum be decomposed with seven equivalents of carbon, the evolution of sulphuric acid is less than in the first case, and the mass taken up by the water yields sulphide of potassium and hypsulphite of potash: the sesquioxide of chromium obtained under these conditions must be separated, by washing in acidulated water, from a certain quantity of sulphide of chromium, Cr_2S_3 , formed by contact with the sulphide of potassium. It is better to decompose the alum with three equivalents of carbon than with seven, because the decomposition is quicker and purer.

The industrial treatment of chrome alum is very simple; it consists of pulverising and mixing the alum with the carbon, and then decomposing it at red heat in a retort of refractory earthenware. The sulphuric acid passes into a series of bitubular flasks, containing either distilled water, carbonate of soda, or polysulphide of sodium. When sulphuric acid is no longer liberated, the decomposition is ended. The obturator of the retort is then withdrawn, and the mass, consisting of sulphate of potash and sesquioxide of chromium, is caused to fall into a cast-iron boiler, water is added, and the whole is boiled to dissolve the sulphate of potash, which is afterwards separated by crystallisation; the sesquioxide of chromium is placed to drain upon cloths, and then calcined to remove the water that remains. This oxide may easily be rendered chemically pure by washing it in a boiling dilute solution of carbonate of soda, thus removing all traces of sulphuric acid which had escaped the action of the pure water. The sesquioxide of chromium obtained by this process is of too dull a green to be used for printing paper or textile fabrics; but, on account of its purity, and the ease with which it may be treated, it is perfectly adapted for making bichromate of potash.—*Comptes Rendus*.

Dr. Vintras.—His Imperial Majesty the Shah of Persia has conferred the honour of the Lion and the Sun on Dr. A. Vintras, Physician to the French Hospital in London, as a reward for the services which this distinguished physician has rendered to the Persian Embassy.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 18, 1869.

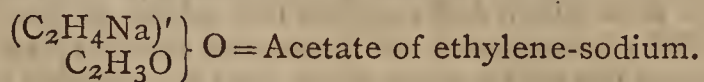
Dr. WARREN DE LA RUE, F.R.S., President, in the chair.

THE meeting opened with the usual formal business, after which

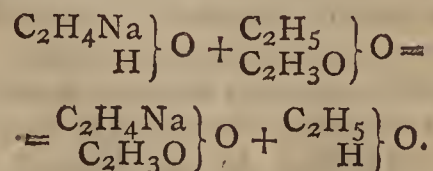
The PRESIDENT announced that the following gentlemen had been selected by the Council, and were recommended to the Society for election as officers, at the anniversary meeting:—As President—Dr. FRANKLAND; as Vice-Presidents—Dr. WARREN DE LA RUE, Dr. NOAD, Dr. ODLING, and Dr. REDWOOD; as Secretary, Mr. PERKIN (in place of Dr. Odling, whose services had done so much to contribute to the prosperity of the Society); as Treasurer—Mr. ABEL; as Members of Council—Mr. MAXWELL SIMPSON, Mr. CHAPMAN, Mr. HANBURY, Mr. PRESTWICH, Dr. VOELCKER, and Mr. GREVILLE WILLIAMS.

He (the President) had another announcement to make, which, he thought, would be extremely gratifying to the Fellows of the Society. The Council had had some anxiety in selecting a distinguished chemist to inaugurate the Faraday lectureship, recently established by the Society; it was felt, that, to do due honour to the distinguished philosopher whom we had lost, we could not do less than seek among the greatest names for one who would accept the duties for which the medal was to be conferred. The Council had applied in the first instance to M. Dumas, whose name was well known to every one present, who was a chemist before some of them were born, whose long career as a man of science, a statesman, and a promoter of the welfare of science, had been so distinguished, and who, above all, had been one of the most intimate friends of Mr. Faraday. M. Dumas had at last consented to accept this post, and this would, of course, necessitate a great number of preparations. A fitting arena for the discourse must be provided; and, through the instrumentality of Dr. Odling, arrangements had been made by which the theatre of the Royal Institution had been secured for the purpose. No site could be fitter for the purpose than that in which Faraday had enunciated so many of his grand discoveries. The discourse would, of course, be delivered in French; but that could be a matter of very little moment, as all the Fellows of the Society were probably acquainted with the French language. It was hoped that M. Dumas's visit to England might be rendered pleasant, and at a future time some little scheme would be laid before the Fellows of the Society by which a fitting welcome might be prepared for him. The discourse would probably be delivered in the month of May, but further information would be given to the Fellows in the course of six weeks or two months.

Professor WANKLYN then gave a verbal account of his experiments on ethylate of sodium. He had arrived at the result that the so-called absolute ethylate of sodium is really the hydrated oxide of a new kind of organo-metal. He had also obtained a set of salts of the new radical—for instance, the acetate, valerianate, and benzoate of ethylene-sodium. The formula of the first is—

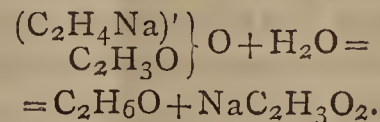


It is obtained by the action of acetic ether on absolute ethylate of sodium, thus:—



Alcohol is, as will be observed, the complimentary product.

The new salts which are isomeric with salts of a higher fatty acid, are characterised by being decomposed by water into ordinary soda-salts and alcohol, thus:—



The elimination of alcohol in this reaction shows that the olefine is associated, not with the acid part, but with the metallic part of the compound. Mr. Wanklyn regarded sodium as triatomic in these compounds.

Mr. CHAPMAN said that if the rotative amylic alcohol were taken, sodium dissolved in it, water added, and the whole distilled, an alcohol of the same rotative power was obtained; if, however, dry alcohol was treated with sodium, the alcohol distilled off, and the residue heated to about 200°, or rather over, this residue remained perfectly white and colourless, and had the composition of what was ordinarily called amylate of sodium. If water was now added, the alcohol yielded on distillation was no longer rotative. Its boiling point was lowered from 132° to about 124°; and the speaker was strongly inclined to believe that it was identical with the hydrate of amylene discovered by Wurtz. It did not yield valerianic acid on oxidation, and its specific gravity was altered. It would be somewhat curious if this observation, made almost at the same moment, were to receive explanation by Mr. Wanklyn's description of these olefine compounds.

Dr. ODLING, without presuming to call in question the interpretation given to his researches by Mr. Wanklyn, whose powers of penetration into chemical phenomena were so well known, and who had had time to consider the subject carefully, remarked that it was easy to understand a difference between such a body as hydrate of sodium ethyl, or sodium ethylene, and ordinary sodium ethylate; but that if this sodium were replaced by hydrogen, he did not see how a difference could be figured between hydrate of a hydrogen ethylene and hydrate of ethyl—how, in fact, such a body could differ from common alcohol, unless, indeed, we were to give to the hydrogen a triatomicity corresponding to that which Mr. Wanklyn ascribes to sodium.

Professor WANKLYN thought that the explanation was that the sodium was combined twice with carbon, and if hydrogen were put in place of the sodium, he did not assume that the hydrogen would afterwards have the combining power that the sodium had. It amounted to this—that the sodium had interfered with the combination at two points, and so converted a normal into an abnormal action.

Mr. CHAPMAN thought that this anhydrous ethylate of sodium would yield common alcohol, whereas the anhydrous amylate, or amylene compound, would, in the same way, yield an abnormal alcohol. The splitting of the alcohol into olefine and water, or the representatives of water, appeared, as Mr. Wanklyn said, to be a result of the disturbance of the relations of the alcohol.

Dr. ODLING remarked that Mr. Wanklyn appeared to think that the alcohol obtained by replacing the sodium of the ethylene compound by hydrogen, would differ from common alcohol,* whereas Mr. Chapman held a contrary opinion. If a different alcohol were obtained, under these circumstances its constitution could not be explained by our at present received notions. We should either have to assume that the atoms remembered, so to speak, the bodies which they replaced, or we must go into the question whether all the atoms of hydrogen in the methyl residue had the same value. This last notion was floating in chemists' minds, but had hitherto received no demonstration.

Mr. MILLS thought that there was some ground for the opinion as to the identity of the different atoms of hydrogen in marsh gas, though perhaps he would not have ex-

* We believe that Professor Wanklyn did not intend to convey this impression.—ED. C. N.

pressed the fact to which that opinion referred in exactly the same way. In the oil known as Marignac's oil, which was marsh gas, in which half the hydrogen was replaced by chlorine, and the other half by nitrile (NO_2), one-half of the nitrile had undoubtedly a different function from that of the other half, inasmuch as on heating with hydriodic acid, one-half became ammonia and the other half nitric oxide. A great deal of further support from fact would, however, be required before the floating opinion, to which reference had been made, as to a difference between the different hydrogens in marsh gas could be generally received; and when it was received it would not support any atomic hypothesis, but would, on the contrary, tend to a much greater result, namely, to make chemistry more dynamical and less statical than it unfortunately was at present.

The meeting then adjourned to Thursday, March 4th, when a lecture will be delivered by Mr. Tomlinson, F.R.S., "On Catharism, or the Effects of Chemically-Clean Surfaces."

PHARMACEUTICAL SOCIETY.

Wednesday, February 3, 1869.

T. H. HILLS, Esq., Treasurer, in the Chair.

Dr. ATTFIELD had already contributed three notes on the following subjects:—

Citrate of Quinine.—A mixture, consisting of sulphate of quinine, citric acid, citrate of potash and water, contained a deposit which prevented the proper apportionment of the dose; an analysis proved it to be citrate of quinine, and, by first rubbing the solid with a little of the water, a mixture was obtained which admitted of the proper dose being taken.

Aromatic Sulphuric Acid.—Experiments proved that the official preparation contained no sulphovinic acid, as had been supposed by some pharmacists.

The Adulteration of Precipitated Sulphur.—An analysis of eight samples showed that only one was pure, one contained nearly half its weight of calcareous matter, and each of the others contained two-thirds impurity, and only one-third precipitated sulphur.

At the present meeting, Dr. ATTFIELD read seven other notes: the first was on

Crystallised Carbonate of Magnesium.—Some unusually large crystals of pentahydrous carbonate of magnesium had been forwarded—the largest was 13 m.m. long, 9 wide, and 6.5 thick. They were converted, by exposure, into the terhydrous salt. 324 of a gramme yielded, on analysis, .0945 of MgO ; 100 parts gave, by experiment, 29.167, and by calculation, 28.988.

Arsenical Playthings.—The author had analysed the wings of a toy bird, and also the label of a cotton reel, both of which contained arsenic; such toys should, therefore, be kept from the mouths of children.

The Separation of Tin from Antimony.—By the usual mode of separating these two metals, too little antimony and too much tin is often obtained. Noticing the best numbers were obtained when the operation was quickly performed, the author endeavoured to find out whether metallic antimony reduced ferric salts to ferrous, the antimony becoming dissolved by the influence of the excess of acidulous radical in ferrous salts over and above that in ferric salts. He warmed two solutions of chloride of antimony—one in a flask, the other in a beaker—adding to each metallic iron and hydrochloric acid. When the iron had disappeared, the flask was tightly corked and the beaker left uncovered. In forty-eight hours, the antimony in the beaker had re-dissolved; but on testing the liquor in the flask no antimony was discovered. On digesting finely powdered metallic antimony in solution of ferric chloride slow reduction to ferrous chloride took

place, the liquid taking up antimony; so that, in precipitating antimony by iron, to estimate the amount of antimony, air must be excluded until all ferrous salt is washed away.

On a Crystalline Deposit in Opium Liniment.—On mixing a liniment often used in pharmacy containing laudanum, a greenish-yellow semi-crystalline precipitate formed, which was analysed to ascertain if it contained any of the active principles of the opium. It was found to consist of the acid meconates of potassium, and mainly sodium with a little sulphate of calcium; its presence was, therefore, of no moment.

In reply to a member, Professor ATTFIELD said it contained no morphia.

Mr. MORSON remarked that the morphia would be kept in solution by the ammonia.

Sulphate of Potassium in Ergot.—In preparing the Ext. Ergot Liq. B. P., a pharmacist had, after mixing the spirit of wine, set the mixture aside during a night instead of one hour. The sides of the vessel were lined with crystals, which Dr. Attfield found to consist of the inert salt of sulphate of potassium. They amounted in weight to about 3 per cent of the ergot employed. After reading the note, the author read a letter from Mr. Holloway, of Sydenham, who sent a sample of powdered ergot, which he had kept in a corked bottle since 1866, by adding about 20 per cent of spirit of wine; it was in a good state of preservation.

White Precipitate.—Six specimens were examined in reference to volatility, fusibility, and percentage of mercury: all volatilised on being heated, without leaving a trace of residue. On sublimation, one partially melted and one liquefied entirely, the others were infusible. The percentage of mercury was as follows:—

Mercury in 100 parts.				
No. 1.	..	volatile	infusible	.. 78.59
" 2.	..	"	"	.. 77.87
" 3.	..	"	"	.. 76.44
" 4.	..	"	"	.. 75.11
" 5.	..	"	partly fusible	73.08
" 6.	..	"	fusible	.. 72.00

The author recommended that in the next Pharmacopœia the quality of infusibility should be included in addition to the percentage of mercury.

Mustard Cake.—Dr. ATTFIELD had analysed a sample of mustard cake which was prepared by pressing the husks of the seeds when hot. It was sold principally for manure, but farmers were liable to get it instead of linseed cake. The following is the analysis:—

Water	..	..	..	..	11.00 per cent.
Ash	..	..	..	..	8.00 "
Fibrous matter	..	..	..	..	12.25 "
Oil	..	..	..	..	14.00 "
Albumenoid matter	..	..	..	..	31.70 "
Mucilaginous matter	..	..	..	..	22.50 "

Sulphurous Acid.—Mr. UMNEY read a laboratory note "On Sulphurous Acid," in which he showed that the officinal solution of 9.2 per cent could only be obtained with difficulty. The described specific gravity did not coincide with its percentage of acid. He had examined several specimens, and found they contained only from 2 to 6 per cent of real acid. Results of experiments on a large scale showed that the specific gravity of strong acid, as ordinarily obtained, was from 1.025 to 1.030. The author suggested that a solution of 1.027 sp. gr., and containing 5 per cent by weight, of real acid, be substituted for the officinal solution.

Mr. HANBURY had always found the strength of sulphurous acid inferior to that ordered in the Pharmacopœia.

Dr. ATTFIELD remarked that either the Pharmacopœia process or the percentage was wrong.

The CHAIRMAN thanked Dr. Attfield and Mr. Umney for their communications, and announced that the next meeting would take place on the 3rd of March.

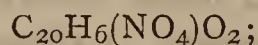
FOREIGN SCIENCE.

PARIS, FEB. 24, 1869.

Lead v. Tin for Water Pipes.—Naphthaline Yellow.—Cholesterine in Wheat, Rye, and Barley.—Determination of the Density of Ozone.—Varnish for Iron.—Sulphate of Aniline a Test for Nitric Acid.

PUBLIC attention has often been directed to the dangers attending the use of lead pipes for the distribution of water. It is quite certain that some waters do dissolve traces of lead. The water obtained on board ships by the distillation of sea-water has been observed to contain lead when a worm of this metal has been used in its condensation. A description of a pipe invented by M. Hamon promises to obviate the chance of this contamination. M. Hamon makes use of a leaden pipe covered with tin; the covering of tin is not obtained by merely fusing tin on the surface of the lead, but by the simultaneous drawing out of two concentric cylinders of lead and tin. This operation is made by means of a hydraulic press under an enormous pressure, and the result is a homogeneous, compact, and unalterable material, which it would be impossible to obtain by other means. Pipes of this description are also far preferable to lead pipes for the conveyance of gas in houses. The ingenious invention of M. Hamon has been the object of several favourable reports from the Council of Public Health for the Seine, the Academic Society of Nantes, the Director of Naval Architecture, and several engineers.

M. Martius has published a note on the dye which is prepared with hydrochlorate of naphthylamine and nitrite of potash, and passes by the names of golden yellow and Manchester yellow. Some have considered this compound as dinitronaphthol or binitro-naphthalic alcohol—



others consider it nitroso-naphthaline; others, again, consider it dinitronaphthol, $\text{C}_{20}\text{H}_6\text{N}_2$. Whatever the colouring matter may be, it possesses a considerable colouring power, and is fixed without any mordant on silk and cotton. In commerce, calcium or sodium are commonly combined with the colouring matter. It crystallises in little yellow needles, and behaves like a powerful acid; it may be purified by dissolving in ammonia and crystallising, and afterwards precipitating by a concentrated solution of chloride of ammonium. Boiling water scarcely dissolves a trace of the yellow colouring matter, which is only slightly soluble in alcohol, ether, and benzol. It decomposes carbonates, and gives, by double decomposition, salts which, in general, possess a yellow or orange colour; this colour is the ammonia salt, which crystallises in needles containing an equal quantity of water of crystallisation. Treated with tin and hydrochloric acid, this colouring matter gives a compound which the author considers as an isomer of alizarine.

The presence of cholesterine in wheat and rye has been observed by M. Ritthausen, and in barley by M. Lintner; the following process is described by the former:—The fatty matter obtained by the extraction with ether or hot alcohol is treated with a little ether to render the olein fluid, which is separated by filtering. The filter is drained, then washed with warm alcohol, which leaves a colourless residue; after boiling with a soda lye of 25 per cent, the residue is melted, washed with warm water, and dissolved in ether, which, after cooling, deposits plates of cholesterine. This proximate constituent possesses the following reactions:—Heated with sulphuric acid, or hydrochloric acid and sesquichloride of iron, it turns blue; it reddens when, after evaporation to dryness with nitric acid, ammonia is added; finally, after prolonged contact with sulphuric acid and chloroform, the solution becomes blue-violet tinted. Palmitine is the fatty matter of rye, that of barley is laurine mixed with a fatty principle intermediate between myristine and palmitine. Bran contains 3.5 per cent of fatty matter, while flour only contains 1 per cent.

M. Soret has made a determination of the density of ozone. Former experiments proved ozone to be an allotropic condition of oxygen, and to be denser than ordinary oxygen. When ozone is treated with oil of turpentine or oil of cinnamon, the diminution of volume is double the increase of volume which results when ozone is destroyed by heat. The conclusion to be drawn from this fact is, that the density of ozone is one-and-a-half times that of oxygen; other experiments tend to confirm this result. The rapidity with which ozone diffuses is considerably greater than that of chlorine, and very close (though a little feebler) to carbonic acid. M. Soret adopts 1.658 for the density of ozone.

Dr. Lunge has published a paper on "The Preparation of Varnishes for Iron as Secondary Products in the Distillation of Coal Tar." Varnishes of this description are very easily prepared by melting pitch with different matters obtained in the distillation. No substances other than those obtained in the distillation of tar are required, and all that is necessary in the manufacture is an iron vessel in a covered building. The form of vessel most convenient is a vertical cylinder slightly concave at the bottom. About as much pitch as would be contained in a three-quart vessel is thrown in at a time, and a small quantity of oil added to facilitate the fusion of the pitch and to prevent its solidifying on cooling. Considerable heat is then applied, and small quantities of oil added from time to time; before adding the whole of the oil, it is important that the melted mass should be allowed to cool sufficiently that the oil will not enter into ebullition. Exact proportions can be of no service, as different degrees of consistence are required for different purposes. Samples are withdrawn from time to time and allowed to become quite cold to judge of the consistence of the material. The oil employed is the heavy oil of tar, and for ordinary kinds of paint for metal, pitch is melted with it as previously described. But for many purposes, a simpler process still may be made use of, especially in the manufacture of large quantities. Tar is placed in small retorts (the ordinary retorts are too large for the purpose), and heated until the heavy oil commences to distil over; then the fire is diminished, and the retort allowed to cool somewhat; the retort is then opened, a certain quantity of heavy oil added, and the mixture well stirred: all that remains to be done is to pour the mixture out, and the operation is finished. Varnish made in this way is preferable to tar, and dries sooner; according to the state of the atmosphere it dries in twenty-four or forty-eight hours. By incorporating naphtha of the lowest quality—to do which the mass must still be warm—with the material made with light oil instead of heavy oil, a varnish may be obtained which will dry in an hour or less.

Sulphate of aniline, in the hands of M. Braun, has become an exceedingly delicate test for nitric acid. In a test glass about 1 c.c. of pure concentrated sulphuric acid is placed (1.84 density); to this is added, drop by drop, $\frac{1}{2}$ c.c. of a solution of sulphate of aniline, prepared by adding 10 drops of aniline of commerce to 50 c.c. of sulphuric acid diluted in the proportion of 1 to 6. A glass rod is dipped into the liquid to be tested, and then into the mixture in the test glass. On moving the stirrer about gently, when the slightest trace of nitric acid is present, red streaks mark the course of the glass rod. Upon the least increase of the amount of nitric acid, the liquid becomes carmine tinted, and the addition of one drop of dilute nitric acid causes the liquid to become a deep red tint in the first case, and then reddish brown. This reaction enables the presence of nitric acid to be detected in commercial sulphuric acid. The author has also observed small quantities of nitric acid in well waters, and the same reaction has shown, most plainly, nitric acid in rain water after a storm. Hyponitric acid produces the same reaction as nitric acid, sharing in this fact the same defect as most of the other processes employed for detecting nitric acid.

NOTICES OF BOOKS.

Disinfectants and Disinfection. By ROBERT ANGUS SMITH, Ph.D., F.R.S., F.C.S. Edinburgh: Edmonston and Douglas. 1869.

By common consent Dr. Angus Smith has become the first authority in Europe on the subject of disinfectants. To this subject he has devoted a large portion of his scientific life; and now, in a compact volume of only 138 pages, he has condensed the result of twenty years of patient study. We cannot too much commend the plan and execution of this enquiry. Almost every page contains evidence of exhaustive, laborious research, guided in its course by the clearest judgment. We seek in vain for some weak point to give us occasion to air our critical acumen. Our duty, therefore, must be confined mainly to giving extracts—criticism being out of the question—for no man living is competent to criticise Dr. Angus Smith on disinfection but Dr. Angus Smith himself.

This book contains within itself the whole subject of disinfection down to the present time. The author draws his information from all ages; he discusses the perfumed pomades of the ancients; the conserve of roses of the Athenians; the purification by fire of the Hindoos, of Hippocrates, and of Zeno of Constantinople; the labours of Hercules, who saved the Elians by draining their marshes; the embalming of the Egyptians; the sulphur fumigation of Ulysses; the anæsthetics mentioned by Pliny and Galen applied to surgical operations.—He discusses these with the more modern experiments of Dr. Petit, Sir John Pringle, Guyton Morveau, Dr. Carmichael Smyth, Fourcroy, Hildenbrand, Dr. Henry, and others; and, comparing their processes with those adopted in our own time, shows that throughout the immense mass of empiricism of a bygone time there runs a thin thread of gold, which he has interwoven with his own researches, and so raised the whole subject to the dignity of an exact science.

It is little surmised how much the ancients knew of sanitary subjects. That sewer air is unwholesome is a proposition which has taken in our time Commissions and Boards of Health many years of hard labour to din into the apprehension of the British public; yet even in Justinian's Digest, in quotation from Ulpian, it is evident that this question was then practically settled. Justinian says, "The prætor took care that all sewers should be cleansed and repaired for the health of the citizens, because uncleansed and unrepaired sewers threaten a pestilential atmosphere, and are dangerous." The world is obliged occasionally to revive its principles.

As an illustration of the exhaustive manner in which Dr. Smith treats his subject, weighing and balancing opinions like a judge rather than insisting upon them as an advocate, we may give the following quotation:—

"It has often been asked—Will a sewer produce cholera, or plague, or cattle disease? We cannot say so, or that every kind of disease may be produced from such accumulations of organic matter. The great epidemics that have passed over Europe seem always to have come from some extraneous source, to act as if planted by seed, and not to have risen up spontaneously here. Without attempting to examine this matter carefully, the result here would seem to be, that whilst the decomposition of organised beings after death produces gases and vapours that are opposed to health, these gases or vapours are incapable of originating, although they may be capable of feeding, some of those diseases, such as cholera or plague, which have been observed at all times to come from a warmer climate. There must, however, be some first origin of these diseases, and we cannot prove that the first origin might not take place in our climate, although it seems probable that it requires a

warmer sun and a richer vegetation than is to be found in the north. This, however, is sufficiently made out—that, when these diseases do come amongst us, they take root with most effect in those places where decomposing matter is found. If we were to suppose a seed of disease planted in a rich, fertile soil of decomposing matter, we should give a pretty fair description of the fostering effect of impurity on disease. It would, in fact, appear as if the putrid matter itself took the disease, and transferred it to the living. There seems to be nothing entirely opposed to this view of the case. The question, however, is and has always been—What is the nature of that substance which may be said to form the seed or germ of the disease? Chemists have been inclined to consider it a substance in process of decay. Physiologists and microscopists have been more inclined to consider it as an organised substance. When Gay Lussac passed a bubble of air into the juice of grapes, and found that fermentation began at once, it was believed that the oxygen was the prime mover, and that, when once begun, the action did not cease. When, however, Dusch and Schroeder found that flesh did not decompose if the air was previously passed through a good filter of cotton wool, some difficulty was thrown on the subject. It would appear as if oxygen were not the only agent in the atmosphere causing decomposition. The investigations of M. Pasteur, who found the subject in this uncertain condition, have advanced it so far that we may now with certainty reason in the belief that organised substances are really found in great abundance in the atmosphere, and that they are the cause of some hitherto entirely mysterious phenomena, even putrefaction included. His object was first to inquire into the possibility of spontaneous generation, and he found that carefully filtered air allowed no organisms to appear in vegetable solutions. He found that near the usual surface of the ground these organisms were so numerous that whenever a vessel containing vegetable matter fit for their growth was opened for a very short time they were found to enter, that in cellars and damp and quiet places, where there was no air or dust floating about, these organisms were fewer, and that, as he ascended the sides of the Alps and the Jura, they diminished in number. A commission of the French Academy confirmed his results. If we examine previous inquiries into the compounds resulting from the decomposition of organic substances, we shall find nothing which is at all calculated to bring out such an intelligible rational view of the origin of many diseases, and also of some phases of putrefaction. Chemists, when they have examined products of the latter action, have found sulphuretted hydrogen, carburetted hydrogen, hydrogen, carbonic acid, nitrogen, ammonia, acetic acid, lactic acid, butyric acid, and numerous uncertain bodies having no activity, and utterly incapable of producing those prodigious results that are found when that force begins to work which produces plague, small-pox, or black death."—(p. 20).

Incineration has been advocated of late as a means of obviating the danger occasioned by the multiplication of dead bodies in and about large cities: Dr. Angus Smith puts the subject in a new light:—

"Many people think that we ought, like some of the ancients, to burn our dead. They do not consider what a terrible proposal they are making. To burn a body without producing the smell of burning flesh is a most difficult thing, and far surpasses the problem of burning our smoke, which, however important, is still left undone. The expense of keeping up such a lake of fire as to consume all our dead would also be, in all probability, too great; let us imagine 1500 bodies roasted to ashes in London every week. We shall not enter into the details of such a large manufactory of phosphates, as we must call it, because it is painful to dwell on the horrors of the picture, and conjure up the details."—(p. 5).

Many other quotations we should like to give, but since every page contains subjects of interest and value, to quote

all the noteworthy passages would be to reprint the book.

To sanitary officers, to municipal and parochial authorities, and indeed to all who are practically concerned for the public health and life—and who is not?—we sincerely commend Dr. Angus Smith's treatise.

Hints to Purchasers of Jewellery and of Watches, with an Account of the Relative Value of the Different Qualities of Gold. By EDWIN W. STREETER, 37, Conduit Street, Bond Street. Tenth Edition. London: Simpkin, Marshall, and Co.

THIS neat little work should be studied by all purchasers of jewellery, for in nothing can the inexperienced be so easily duped as in the purchase of gold and silver ornaments. The first part of the book contains some valuable hints on quality and workmanship which, if adopted, will soon lead to the public obtaining a fair value for their money. With regard to the quality of gold, our author very properly remarks that "*Colour* is no guide, as it may be gilded; *weight* is no guide, as it may be loaded with lead; *pattern* and *finish* tell for nothing to the inexperienced eye," but to prevent deception, the purchaser has only to make himself familiar with the standard estimates and to request that the quality be stated on the invoice. The stamp of Goldsmith's Hall is thought by most persons sufficient security, but this is not the case with gold, for the same acts of Parliament allow gold to be marked and sold from standard of 22 carat, worth £3 17s. 10½d. per oz., to an alloy containing gold of 1 carat, worth only 3s. 6d. per oz.

The second part contains a most interesting description of the manufacture of jewellery and watches by machinery. The space allotted to this notice will not allow of our commenting more at length on this division, suffice it to say that a presentation watch seen by us and made entirely by machinery at Mr. Streeter's Establishment proves the great advantages gained by economising labour and thereby greatly reducing the cost.

This readable little book is beautifully printed on fine toned paper and we commend its perusal to our readers.

CORRESPONDENCE.

HEATON'S STEEL AND IRON.

To the Editor of the Chemical News.

SIR,—In the last number of the CHEMICAL NEWS, I find you state that neither of the bars of steel designated as 10 B or 10 C in Dr. Miller's report have been analysed, and that it remains to be proved how far the impurities in the crude steel had been eliminated by the subsequent treatment it was subjected to. In reference to this remark I beg you will allow me to state that two of the bars of hammered cast-steel, made in the experiment conducted by Dr. Miller and Mr. Mallet, were analysed by me some weeks since, and the results as to the amount of phosphorus were communicated to the Chemical Society at the meeting on the 21st of January. Those bars had been tested by Mr. Kirkaldy as to their tensile strength, and are referred to in his report as Nos. 1077 and 1082. The amounts of phosphorus found in them were .241 and .240 respectively, as stated in the CHEMICAL NEWS of the 29th of January.*

I will take this opportunity of mentioning that the fallacy which your correspondent, Mr. Williams, ascribes to me, in reference to this subject, exists only in his

imagination. No opinion was offered by me as to the quality of the steel, and my communication was restricted to pointing out the fact that steel of considerable tensile resistance contained an amount of phosphorus much larger than had previously been observed to exist in steel of good quality.

According to the statement of Mr. Williams, he would appear to be master of an amount of knowledge and opportunity of judging respecting this subject which do not fall to the lot of most chemists, therefore it might perhaps be regarded as presumption on my part to endeavour to justify myself in regarding the tensile strength of steel as a character which the presence of phosphorus would be most likely to affect, provided the commonly received opinion as to the influence of that substance on steel be correct. For this reason I will not venture to offer any reply to Mr. Williams's letter, but will merely express my hope that, in his next communication, he may, from the abundance of his resources, confer upon chemists the benefit of somewhat more fact and less opinion.—I am, &c.,

BENJAMIN H. PAUL.

8, Gray's Inn Square.
February 24, 1869.

SPURIOUS GUANO.

To the Editor of the Chemical News.

SIR,—Many of your agricultural readers will doubtless be interested to learn that a material now offered for sale at the price of £11 per ton, under the attractive title of "Bi-phosphated Peruvian Guano," is not Peruvian guano at all, but a manufactured article, which, from its composition, presents a greater resemblance to superphosphate of lime, of a value less than one-half the price asked for the material which is now offered under a name calculated to convey the idea that it is even superior to true Peruvian guano, though it does not contain much more than one-third the amount of ammonia generally present in this manure, and an amount of phosphates no greater than would be present in superphosphate at about £3 per ton. The sale of trashy manures is now so extensive that this instance of the practice may be worth your notice.—I am, &c.,

BENJAMIN H. PAUL.

MISCELLANEOUS.

A Brilliant Idea.—The *Scientific American* contains the following suggestion to Baron Von Liebig:—"Justus Von Liebig, the celebrated German chemist, recently told a friend that, during the last ten years, he had received seven calls from American universities, and that twice he felt strongly tempted to go to the United States and accept there a Professorship. We trust that Liebig will visit this country and give our people the benefit of his varied stores of information; but we cannot advise him to cover up his light under the bushel of a college professorship. If the Baron wishes to make his name and fame conspicuously useful, he had better accept a position upon the editorial staff of the *Scientific American*, through whose columns he could reach and educate a hundred thousand minds each week."

Poisonous Dyes.—M. Tardieu, the celebrated French chemist, has made some interesting and important experiments with red stockings imported from England. After extracting the colouring matter, he introduced a certain quantity of it beneath the skin of a dog, which died in twelve hours. A rabbit similarly treated expired in eight hours, and a frog in four. Opening the animals, M. Tardieu re-extracted the red colouring matter from their

bodies, and with it dyed a skein of silk. In his report, communicated to the Académie des Sciences, M. Tardieu condemns the use of the "coraline" (the mineral (*sic*) poison to which the fatal stockings owe their brilliant but deceptive hue) as an article of general commerce; and recommends that the importation of red stockings from England be absolutely prohibited.—*Manchester Guardian*.

The Zirconia Light.—The Paris correspondent of the *British Journal of Photography* gives the following account of this light, with which some parts of Paris are now illuminated:—"On Saturday evening I had the pleasure of seeing the experiment of lighting, by means of the oxyhydrogen light, as applied to towns, &c. It was the third time I had been to the Tuilleries in order to see this illumination so that I could report to your readers, and I am able to report most favourably as regards the general effect. The most striking peculiarity of this light, as perfected by MM. Tessie du Mothay and Maréchal, is its perfect steadiness and freedom from flicker. It was the first remark made to me by a bystander—"How steady the light is!" The zirconia cylinders or balls are placed inside the ordinary street lamps, and the jet of mixed gases plays upon them. The light, although very brilliant, is not so painful to the eye as the electric light, and diffuses itself better. You see a globe of pure white light, about the size of a large marble, perfectly steady, and throwing its moonshine rays all around. The contrast between the lamps lit up with this light and the ordinary gas jet is very striking in two particulars, and I had the opportunity of comparing them side by side. The gas-light is yellow, wavering, and flickering, and comparatively dull; the zirconia light is white, steady, no flicker, and brilliant. I have seen many attempts to introduce the electric light for lighting streets, &c., but it is too penetrating, and the light is blinding, even at a distance, to those who are making towards it; and everything, except in the rays of this light, are in total darkness. The effect is like that of a policeman's lantern, which enables him to see all before him, but which keeps him and his surroundings hid from all in front of him. The zirconia light is free from this defect. The question is, can the oxygen gas be procured cheaply enough, and this is asserted in the most positive manner."

Ecole Pratique des Hautes Etudes, Paris.—The new school and the laboratories at the Sorbonne, which have been fully described in the *Journal of the Society of Arts*, were expected to be opened in the course of January. M. Milne-Edwards, Dean of the Faculty of Sciences, has recently made a report to the Academic Council of Paris upon the progress, with one important change, made in the arrangements for the new high school and laboratories. The faculty already is in possession of two physical laboratories, one for instruction under Professor Desains, in which candidates for the degree of Licentiate or Doctor may learn the management of instruments of precision, and exercise their faculties in the repetition of classical experiments relative to heat, light, electricity, magnetism, and acoustics. The rooms set apart for this purpose have been found in three old houses, close to the Sorbonne, and placed temporarily at the disposition of the faculty, and they will very shortly be opened four times a week to the pupils. The second physical laboratory is for scientific investigation, and is installed in a new building erected by the municipal authorities expressly for the purpose: this is under the direction of Professor Jamin, and was opened in the middle of last summer. The large chemical laboratory, under the direction of M. Sainte-Claire Deville, assisted by M. Schulzenberger, was to be opened early in the present year. The practical study of mineralogy is to be carried on in the study of M. Delafosse, once a week at first, but afterwards twice, if necessary. There are provided two geological laboratories, both under the charge of Professor Hébert, and to be opened twice a week. The study of botany is to be divided between the Sorbonne and the

Museum of Natural History at the Jardin des Plantes; the laboratory of the faculty, directed by Professor Duchartre, to be devoted to dissection, microscopic examination and analysis. A new arrangement has been made with respect to the study of comparative anatomy, which will be divided between the Jardin des Plantes, the Collège de France, and the Sorbonne, the dissection of animals being studied at the first of these establishments. With respect to experimental physiology, a laboratory is now being arranged by M. Claude Bernard, but on a scale much too small for the purpose, but which will doubtless soon be enlarged. Lastly, says M. Edwards, the faculty intends to complete its arrangements by the opening of a reading-room, in which the students of the new high school may consult the various scientific periodicals, and make use of the time that will necessarily elapse between the lessons; for this useful object the professors have given up their common room until a new one can be provided. It is quite evident that the Minister of Education and the learned Dean of Faculty are determined to carry out the intentions of the government with vigour, and it would be the fault of the young men themselves who are devoted to scientific pursuits if they do not make progress, not only in educational, but in original investigation. The professors are the most celebrated in France, and the means provided are such as no university in the world offers for high scientific study. It will be strange indeed if a field so well prepared, and in such good hands, should fail to be fruitful.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News." A more complete list containing the omitted papers and contents of journals devoted to other branches of science, is published at the Patent Office, in the library of which the periodicals themselves may be consulted.)

Comptes Rendus.

November 23, 1868.

P. A. FAVRE, "Researches on Electrolysis." F. P. LE ROUX, "On the Behaviour of the Native Chlorides of Sodium and Potassium towards some Metallic Vapours and especially towards the Vapour of Sodium." CHABRIER, "Researches on Nitrous Acid." F. FOUQUÉ, "On some Gases Evolved from Petroleum Wells situated in different parts of North America." F. FOUQUÉ, "On the Composition of the Gases mentioned in the preceding paper." E. GRIMAU, "On Cinnamate of Benzyl." G. VILLE, "On the Presence of Sulphate of Ammonia in the Lagoons of Tuscany." PINCUS, "Note on the Author's Claim to the Invention of the New Constant Battery described by Warren de la Rue and H. Müller."

November 30, 1868.

E. BECQUEREL, "On Diffusion, Electro-capillary Phenomena, the Formation of Oxides, Silicates, Crystallised and Hydrated Aluminates, and on the Effects of Diffusion between Liquids which do not mix with each other." H. DEVILLE, "On the Temperature of Flames, and on its Relations to Pressure." P. DESAINS, "Researches on Obscure Calorific Spectra." BONJEAN, "Note on the Therapeutic Properties of Ergotine." FRITZSCHE, "On some New Hydrocarbons." "On a Phenomenon resulting from the Fracture of Tin when Exposed to Intense Cold." STAS, "An Improved Method of Testing Silver in the Wet Way." F. JOLYET and A. CAHOURS, "Note on Crum Brown and Fraser's Memoir on the Physiological Action of the Salts of Methylstrychnium."

Poggendorff's Annalen.

No. 10. 1868.

F. WIEDEMANN, "On the Magnetism of Chemical Compounds." O. E. MEYER, "An Explanation of B. Stewart and P. G. Tait's Experiment on the Heating of a Disc by Rotation in Vacuo." A. KUNDT, "On the Spectrum of Lightning." A. POPPE, "On the Form of the Flame of Bunsen's Burner." H. GEISSLER, "Some New Experiments on the Production of Light in Vacuum Tubes."

Annales de Chimie et de Physique.

October, 1868.

P. SCHUTZENBERGER, "Memoir on the Colouring Matters extracted from Persian Berries." A. BOBIERRE, "On the Action of Sea Water on the Sheathing of Ships, and on the Methods of Investigating the same." F. KUHLMANN, jun., "On the Extraction of Sulphur from the Solfataras of Sicily." BERTIN, "On some New Induction Machines." E. JUNGFLISCH, "Researches on the Chlorinated Derivates of Benzene."

Bulletin de la Société Chimique de Paris.

November, 1868.

BERTHELOT, "On the Direct Transformation of Marsh Gas into more Condensed Carbides." "On the Hydrides of the Hydrocarbons." "On some Modes of Formation of Styrolene." E. KOPP, "On the Condensation of Hydrochloric Acid Gas in the Manufacture of Chemical Products."

Journal für Praktische Chemie.

November, 1868.

C. JESSEN, "On the Constituents and Decomposition of Starch Grains." J. LOWE, "On Catechu and Catechu-Tannic Acid." W. STEIN, "On the Colouring Matters extracted from Persian Berries." G. LEUCHS, "On the Valuation of Indigo." LIEBEN, "On the Synthesis of Alcohols by Means of Chlorinated Ether." F. GOPPELSRODER, "On Melopsite."

NOTES AND QUERIES.

Dyes from Ochella Weed.—Can you or any of your correspondents inform me what is the distinctive character of the tinctorial matters recently prepared from ochella weed, under the names orceine, eriphthine, and eryphic acid? How do they differ from archil and cudbear, and from each other, and how are they made?—CHROMO.

Picrate of Quinine.—Aniline Black.—Can you inform me, through "Notes and Queries," if picrate of quinine has been used as a medicine, and what dose, and what effect? Also, if there is an aniline black for cotton—I can find none in any published work. I want to find it, if the process exists.—NEW BERNE.

Utilisation of Waste Heat.—"W. F. K. Stock" is referred to the work "Abridgments of Specifications relating to the Preparation and Combustion of Fuel, A.D. 1620—1865," published by order of the Commissioners of Patents, 1867. One volume in octavo, 1409 pages, price 17s. May be inspected at the library of the above-named Commissioners.

Austrian Non-Explosive Blasting Powder consists of 30 per cent of nitrate of potash, 40 per cent of nitrate of soda, 12 per cent of sulphur, 8 per cent of charcoal, 4 per cent of pit-coal, and 6 per cent of tartrate of potash and soda. This powder is explosive only when it has been rammed tight, and is then ignited by means of an explosive fusee. It is in very general use in the mining and quarrying operations in the Austrian Empire, and is far less expensive than ordinary blasting powder.

Chemistry of Food.—Charles Hunter.—This correspondent, in reducing the "grains per lb." to percentages, according to tables 3 and 4 of Dr. Letheby's lectures (see vol. xviii., pp. 79 and 80), found a difference in the tables. In table 4, beef is said to contain 2301 grs. of carbon and 175 grs. of nitrogen per lb.; whereas, from table 3 giving 72 as the percentage of water, our correspondent judges that the total solids could not exceed 1820 grs.; according to his calculation, 16 is the percentage of N in albumen, 52 the percentage of C in albumen, and 48 the percentage of C in fat. Dr. Letheby has, with his usual courtesy, sent us a very full explanation, which we subjoin, for the benefit of all our readers, as well as our special correspondent. Dr. Letheby says:—"In the first place, your correspondent has not used the right numbers in any of his calculations; for the pound referred to is an avoirdupois pound of 7,000 grs., and the percentage proportions of carbon in fibrin, &c., and fat, are 53 and 77, instead of 52 and 48, while the percentage amount of nitrogen in the nitrogenous matters of meat is 15.4 instead of 16. But, even with these proportions, it is quite true that the amounts of carbon and nitrogen in table No. 4 do not in all cases correspond with the calculated proportions from table No. 3. To take the case in point, lean beef and fat beef of table 3 would have the following amounts of C and N per lb.:-

	C.	N.
	grs.	grs.
Lean beef	910	208
Fat beef	2155	160
Mean	1537	194

Neither of which numbers agree with those for beef in table 4; and the discrepancy arises from the circumstance, that in most cases the numbers in table 4 were obtained by actual analyses. Beef, however, like all other flesh, differs very considerably in the relative proportions of water, nitrogenous matter, and fat; and it would seem, from the proportions of carbon and nitrogen in table 4, that the beef must have contained the following percentage proportions of fat and nitrogenous matter:-

Fat	31.6 per cent.
Nitrogenous matter	16.2 ..

And these proportions are not very different from the proportions which Messrs. Lawes and Gilbert found in the carcasses of half-fat and fat oxen; for, in their paper in the *Transactions of the Royal Society*, they give the following as the percentage amounts in the two cases:-

	Nitrogenous matters.	Fat.
Half-fat ox	17.8	22.6
Fat ox	15.0	34.8
Mean	16.4	28.7

Dr. Edward Smith says, in his "Practical Dietary," "that, on taking equal parts of beef and mutton, and a fair sample of the joints, and

deducting one-tenth of the weight for bone, we find that there are 2650 grs. of carbon and 157 grs. of nitrogen in each pound" (p. 79). So that, taking all the numbers in the several cases, it would seem that the proportions of carbon and nitrogen per pound of meat stand thus:-

	C.	N.
	grs.	grs.
Fat beef (table 3)	2155	160
Mean of Lawes and Gilbert	2155	177
Beef and mutton (Smith)	2650	157
Mean	2320	165
Beef (table 4)	2301	175

And, considering that Smith's proportions of carbon are a little too high, and the nitrogen a little too low, on account of the mixture of mutton with the beef, it may be fairly assumed that the amounts which I have given for beef in table 4 are very near the truth."

MEETINGS FOR THE WEEK.

MONDAY, March 1st.—Medical, 8. Annual Election.

London Institution, 6.

Royal Institution, 2. General Monthly Meeting.

TUESDAY, 2nd.—Royal Institution, 3. Rev. F. W. Farrar, "On Comparative Philology."

WEDNESDAY, 3rd.—Society of Arts, 8.

Pharmaceutical, 8.

THURSDAY, 4th.—Royal Institution, 3. Dr. Harley, "On Respiration."

London Institution, 6.

Royal, 8.30.

Chemical, 8. C. Tomlinson, F.R.S., "On Catharism, or the Effects of Chemically Clean Surfaces."

Royal Society Club, 6.

FRIDAY, 5th.—Royal Institution, 8. W. Huggins, Esq., "On some Further Results of Spectrum Analysis Applied to the Heavenly Bodies."

Geologists' Association, 8.

SATURDAY, 6th.—Royal Institution, 3. Dr. Odling, F.R.S., "On Hydrogen and its Analogues."

TO CORRESPONDENTS.

Chemicus.—This correspondent, who wanted to know of a good work on pigment colours, is informed that a letter is waiting for him at our office.

F. E. S. Jerningham.—We regret our inability to furnish information respecting Winter's electrical machine.

Knife Edge.—An angle of 30 degrees appears a little too acute for an agate knife edge; we have seen them as obtuse as 60°, and work very well.

H. H. G.—Hopkin and Williams.

G. E. D.—You seem to have read nearly all the books we could recommend.

D. John.—The product of one distillation at 100° C., will be very far from pure benzol. The benzol should be separated from the naphtha by fractional distillation, and then purified by freezing.

H. How.—The article received with thanks; it shall be inserted in an early number.

Communications have been received from L'Abbé Moigno; A. Steel; J. Rothschild; Professor H. How, Nova Scotia; D. John; R. Berry; H. Noyes; J. J. Lish; C. G. Williams, F.R.S.; J. Spiller; Professor Wanklyn; Professor Heaton; H. Hudson; R. R. Tatlock; Professor Brazier; Professor Atfield; W. T. Suffolk; Dr. E. Fleischer, Dresden; F. E. S. Jerningham; C. Hunter; J. Barrow; Dr. Paul; Miss Lydia Becker; W. Neill and Son; A. Maurice; W. Mackenzie; W. White; G. H. Brown; A. Carter (with enclosure); The Runcorn Soap and Alkali Co. (with enclosure); Mawson and Swan; J. Simpson; L. Demuth and Co.; J. W. Lumley; N. Lincoln; J. F. Dickson; J. M. Dluith; T. De La Rue and Co.; Professor Hinrichs, Iowa City, U.S.; Dr. Muter (with enclosure); W. Cass; W. H. Perkin, F.R.S.; F. Sutton, F.C.S.; H. D. Collingwood; Lumsden and Son (with enclosure); B. Wheeler (with enclosure); T. Geeves; J. and W. Rickard (with enclosure); Burnard, Lack, and Co. (with enclosure); Dr. Andrews (with enclosure); Albright and Wilson (with enclosure); and Dr. Odling, F.R.S.

BOOKS RECEIVED.

Causeries Scientifiques, Découvertes et Inventions, Progrès de la Science et de l'industrie. Ouvrage orné de 72 vignettes et d'une Chromolithographie, Huitième Année. 1868. Paris: J. Rothschild, Editeur.

The Law to Regulate the Sale of Poisons within Great Britain. By William Flux. London: John Churchill and Sons.

More Light: a Dream in Science. London: Wyman and Sons.

Report of the Manchester Scientific Students' Association, for the year 1868. Manchester: Cave and Sever; Edwin Slater.

Braithwaite's Retrospect of Practical Medicine and Surgery. Part LVIII., January. Uniform American edition. New York: Townsend and Adams.

American Reprint of Chemical News. February.

THE CHEMICAL NEWS.

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SETTING TO WORK.

BAD as man is, he is too good to be quite pleased with the present—too good not to feel sympathy with the struggles of the past, and too good not to hope for a better future. The present we see, so far as our eyes permit us; the past we almost see beside us, in nations that have little changed; and the future seems to be forming almost before our eyes. In a very wonderful picture of the English race moving over the world with cities of civilisation as numerous as the tents of those former men who carried desolation before them, we learn in Mr. Dilke's "Greater Britain," that, even west of the Mississippi, 22,000,000 of acres of land have been devoted to the purposes of education, and millions on millions are to follow. The whole of England and Wales contain only 38,000,000 acres of land not so rich, but all that American expanse is at once made sacred. As a result of a similar policy in Michigan, a university has arisen, which teaches for a sum which may be considered merely as an acknowledgment of its position—10 dollars for entrance, and 5 dollars annually afterwards. Michigan is of the same size as England and Wales: it has 38,000,000 acres. This our country has turned into many by a kind of gemmation, and principles grown amongst us, but not carried out, are flourishing among people whom circumstances, perhaps, have enabled more honestly than us to do as we feel we ought to do. We see our future growing not far away, but it seems to us as a kind of martyrdom to enter it. It is already a law that no man shall die for lack of bread; it is not yet a law that no one shall sink into worse than death for lack of teaching. But we must arrive at this point—our nature decides for it. We compel every child over whom we have influence in private life to learn, and, as our hearts enlarge, our influence will widen its circle.

This expansion has shown itself lately. The exertions of private men have been incredibly great, and the work which some have done places them so high that we can no longer doubt that even our generation can produce heroes that no age would despise. But the work has been insufficient; a private man among thousands does good, but it is too little, and the man dies of exhaustion, or at least by time. An agent from the Government comes, the people crowd around him, he is received with delight, and the work is done to the extent required—and sometimes further—in any department to which the Government turns its attention. There are two departments of education, which show what local interests can do and what Governments can. The church, of which we are not authorised to speak, has been preserved by the state, without loss of income and in full power. The schools for the young, left by individuals, or in the hands of small irresponsible boards, have gone, in numerous instances, to ruin. We cannot argue fully the whole subject, but we think these facts give fair arguments. In Scotland, the parish school system, also, has been preserved, because defended by Government. It may be said that the parish schools have not grown with the age: it is true; but they have not had their small stipends used for feeding the wealthy, and growth has not been entirely absent. Had provision been made for growth, the system had been perfect.

And now what is Government to do? And are we to begin to be the ten-thousandth instructor of Government, and lay down a plan which we suppose all men will follow? No, we do not intend to lay down systems for

the nation; we think that peculiarly the work of legislators—of men who know the mode of carrying out principles among their fellow men. We prefer to speak less ambitiously; we think it proved, by the experience of some three hundred years, that the state can take care of revenues for education. Can it also take care of education? On this point, most people will say that it has done so too rigidly, and that an expansion from time to time was desirable. A judge was told by a barrister that a certain act demanded that a large disputed sum should be unreservedly in the hands of a very young claimant. What said the judge? "Am I going to allow a young man to be ruined, simply because of some words in an Act of Parliament." Here was discretion. All men are not capable of a wise discretion; and the constant opposition to everything proposed has prevented movements which the spirit, but not the letter of laws, dictated.

To keep up the standard of education is really the business of the universities, and to them we must look for examiners. There is no man more important than an examiner; he rules the youth of to-day: he has more influence on them than all the previous and existing thinkers of the world besides. To please him, the young men read, and they learn his ideas; he has his opinion—he even has his crotchets, and they are received with respect. This is an evil that arises from one set of examiners, and a reason why a nation must have several. The same reason applies to universities. France prefers to carry out one idea—to model her schools on one pattern; there is something grand in it. One only can be perfect, and why, then, have two patterns. It is the perfect way of the heavenly future, but can be right only for a nation that cannot go wrong. To make many millions think on one model, is, one would suppose, the surest way to suppress originality. It will have its effect; there must be many tastes among many minds. We believe that one great university will mould a nation more thoroughly than many will; but we prefer the waywardness and eccentricity that are the diseases of men of original character to that uniformity and smoothness which we think will be produced by the military school system.

In the fulness and freedom of our universities, we shall have, perhaps, the best guarantee of the education being the most advanced. When untrammelled in teaching, and their revenues guided, they may not become so disinclined to move as in past times. When public opinion itself sinks, who is to raise it? When new branches of knowledge arise, who is to provide for the new teachers? If all the funds are given to those of to-day, there must be less to each if the numbers are increased to-morrow. In such a case, there is the plan well known—first come first served; and there is the other plan, not unknown either—to give Benjamin the largest share. There are, also, intermediate plans, if no other funds can be got; but is anything sadder than to leave untaught a great department of knowledge, simply because the funds are already granted to men who have never served any but themselves.

It is hoped that no such questions will again arise, but that a free intercourse between the state and the universities will cause abundant provision to be made for all laudable pursuits. As a rule, men will fight for themselves; and it is a fault of a nation if it allows laws which incite men to resist the public good in order to advance even their moderate wishes. Men commit crimes sometimes from want of knowing that better results could be got for themselves without crimes.

Surely if a state preserves or gives the property, the universities may give the learning. If any of these should become wild, and teach doctrines opposed to the nation's better feelings, the state must interfere, but not otherwise; toleration ceases with all men at some point. No one discusses the propriety of murder—the question is settled; but we discuss capital punishments, because there are wise men of opposite opinions. To what body is it possible to give this lofty supervision, except to the state,

which, moreover, by the will of nations, takes it of a necessity.

But if the property is thus preserved, and the learning secured, what shall be done with both? At present, the principal inclination is to encourage study by prizes and scholarships. We believe, that by a simple minute at the end of 1867, the Government has decided the fates of the children for many years to come; they will learn more science—they will change the character of the nation; there will be a greater audience for words lectured or read, and the national mind will speak more strongly on scientific objects.

We have begun by encouraging scholars with money; in England monied men send their sons where money prizes can be got. We teach the child to read by a sweetmeat; but this may last too long. If it endures three centuries, like some of our educational habits, so much the worse for this country. In America, it is already ceasing, competition for prizes being considered hurtful; and in a great university, which does not even take money for teaching, it is unseemly for students to fight for mere gain.

We should prefer to see more rewards given to those who had spent their strength and their lives, serving their age by their studies; we think that this class of reward ought to increase, whilst student rewards diminish. Many a precious life has been destroyed by long fellowships without duties, and many have been rendered unhappy by having the aid removed at a time of life when it was most required. It seems proper, and according to natural law, that the finished student should, as a reward, have work given him; that is the true fellowship. We could point out students under twenty making so much money by prizes that it would be considered as a very handsome pension by old scientific men. Yes, we could point out one who has written papers by scores, and spent thousands of pounds on science, who would be glad of it. True, these student incomes do not last above two or three years; but fellowships last longer, or, on certain conditions, for life. At this moment there are men who have devoted themselves to various branches of science, ready at all times to give their knowledge to all who ask for it; we must confess that we should prefer fellowships going to such men rather than to those who were only eminent students. The reward of the student arises from an old idea that he who had studied a master had completed his knowledge; the modern idea has a boundless nature before it, and he who has finished his university studies is only beginning his career. The student has life and hope before him; study is a privilege now, in an intellectual age when we need rather to diminish the desire, lest the brain should suffer, and when men row or run as a discipline, instead of as in ancient times making a business of sports. We know the opposing arguments, but we still say—give work to the young and rest to the old. For ourselves, we believe that a house must be very poor that has not a warm corner for the oldest, who has done his work or the greater part of it; and the hearts in it must be poorer still if they do not delight in giving to such the finest delicacies at meals. Many severe and true things have been said against sinecures, but no civilised man ever included such as these. Families must have them; no nation with a clear intellect can be without them, because, even without a heart, it may see its advantage in rewarding well done work. We believe that in this direction rewards for scientific men would be wisely increased rather than for mere students. The chimney corner of the nation must be kept warm.

We know well another side. What is finer than to see the adventurous youth struggling for a prize whereby to live, that he may study, and, by pure force of genius, lifting himself out of poverty and hopelessness to honour and applause. We hope prizes for this purpose will continue in our universities until poverty shall cease; but when one has learnt, make him work.

Of course there are many other modes of viewing the

subject; we may take one becoming very popular of late, we may call it the Fijian. The aristocratic party of a Fiji island held that a man at forty, having lost his agility, might, for economy's sake, be eaten. It is easier in those places to tell when a man is of value than it is with us; they can measure the amount of food he brings home, but the value of our men may be in a single thought, and we treasure the individual, listening as to an oracle, not knowing what effects on the world the next word may cause. Even in an economical point of view, we object to the Fijian method. A little sickness or headache is often followed by a long time of great activity; but we have heard of a young Fijian, who had somewhat lost her appetite, and, looking out of her hut, saw at the door her grave, into which she was thrust, and covered up by the work of five minutes. We adopt Fijian policy in many cases here, when a man is paid by the number of strokes he gives a hammer, and when tired is sent off to seek in the workhouse the only compassion that a nation can give by deputy. It seems needful in many cases, because we must struggle against deception; but as men rise in the scale of humanity, the hard reasoning ceases to guide them, because reason is unable to estimate the value of a good man.

These points are all interesting, but we must not go too far aside from the main interests of scientific men. The greatest favour which a nation can do them is to give them employment, each according to his kind. Perhaps some may suppose that we are now going to devise situations for them, and propose to clamour that all these shall be filled up instantly, so that no longer shall men of science be without honour and comfort. Well, if we could, we would situate them all well; and, after all, there are not so many in the nation as to make the burden too heavy. But it is not to be done: they must fight like other men—"man must go out among his foes working and struggling." Still we ask—How shall a nation best make use of that peculiar power obtained by the study of science; how shall it organise those invisible forces, as it has organised the army and navy, and the equally invisible courage of the human heart, that prompts ever to resist aggression? These great questions must be settled for national, and not merely private benefit, and then more time will be given for warming the chimney corner, which, after all, is not the least of things.

It has taken many centuries to reduce an army to order—its equipments have been changed in our own day; and the navy is now in process of change. Since Marcus Graecus burnt saltpetre, sulphur, and charcoal, and made something like a rocket project, the changes have been many, the principle one.

We have gone to Alexandria for our systematic scientific beginning, and the museums of Europe are parts of the system begun of old. Perhaps our British Museum is the truest model we know. These museums are increasing over the country. They are becoming associated with parks; and a beautiful beginning of this kind we have in that admirable spot at Kew. It does seem to us that to add learned persons in real life to these institutions is a true policy. These places offer fine opportunities for lectures, and it is a question whether it is not well to imitate Paris in her Jardin des Plantes, and have these lectures free. A thousand objections arise; we know most, but we know something also of the people of England, and we are persuaded that the logic of facts is always sure to find among them ready listeners, whilst they are ever ready to make flights by that most delightful of methods, a train of thoughts. These lectures ought not to be profound. We hear lecturers complain of want of attention. If you speak Greek, how do you expect English people to understand you, even if they have been at a university? The profoundest thinker may find it hard to teach the meanest child. People imagine that it is because he knows too much, but this is a mistake, it is because he knows too little. He has passed in a kind of balloon, or in an inflated sort of way a whole region of thought, the

very region which the child wishes to travel, but the poor thing can get no guide; and by degrees it is of necessity driven to take the same balloon passage, or some night conveyance. Let the truth told be worth thinking of, and earnest men will come; let them be interesting to the imaginative, and light thinkers will come; let them be cheerful as nature is cheerful, and the gayest will come. Already children are rising up that require science among their thoughts; and the active intellects that are growing more numerous will do evil if not good. We think this a fine field for scientific work. We have few towns with scientific men in them. There is a dreary lack of them in many places, and it is absolutely needful to fill up this lack as salt is to preserve meat. We have torn down the superstitions of our ancestors that filled their active minds; we have taken from our Northmen and Celts their numerous and interfering spirits, and removed from them the society of the spirits of the dead and the wandering doubles of the body; we have taken away the interesting fairies, trolls, and brownies, and we have stopped the mild and merry adventure that brought glory on the sea, and frightened the sea-board from Thule to Constantinople. It is true we have taught the duties of a calmer life, and we desire no longer to return to the past and its faith, but we feel the need of substitutes for the imagination and for the bodily, active, and porpoise-like delight which made our dreaded ocean a place of rest to rovers. The nation makes to itself a substitute by roaming over the world, but the many at home want interest also, and there is more than enough for any man, in science, art, and general progress. We have seen men pining in country places, in villages, and even in large towns, and we are convinced that, by good teaching, double power could readily be produced in this nation. The old arms are useless; we must make the new ones and distribute them.

The teaching of science in schools, and keeping it alive in museums, seem two important methods now begun. Let benevolent men further them. These are not the only modes: some time ago a movement was made to induce corporations to appoint scientific men—chemists—to analyse food, and to see that it was sold in purity. This was a fine opportunity of diffusing science and its benefits. Will town councils refuse it because, perhaps, the analyst will not have enough to do? It is an opportunity for having a scientific man to consult; and he might be rendered useful in many ways to men who are far too much inclined to go on their own judgment, which, of course, can only be the average of intelligent—not specially trained men. Food alone will not occupy the time probably. It is a much to be lamented thing that scientific advisers are so constantly rejected or ignored in the government of cities. We think the chemist particularly required: his life has been looked on as a parasite of medicine, but he is really a separate man. We are unable to tell the many things for which a chemist might be useful in a city, but if he only prevented houses and and whole cities being built with bad bricks and mortar, he would be worth his weight in solid gold, and much more.

The work is not for any one class of men. Meteorology and astronomy, so often going together, are beginning to come more actively into daily life than usual. The use of the latter is old; and the State has made by its aid guides for the sea, and even for the land. Its younger sister is now rising into fame, and the museum will never be complete without an establishment that is always so interesting to Englishmen, and which promises to give us some knowledge of the regions of the air, and to guide us in commerce and in agriculture, which at present so peculiarly demand our attention. And here we come round to chemistry again, brought by our numerous shipwrecks. Does it not seem strange, that a nation that depends so much upon iron should not be able to tell the composition of a good ore, or of a sound piece of metal? Few iron companies, that we know of, keep a chemist constantly occupied with the subject, and men in London, for

the love of pure science, must find whether there ought to be phosphorus in good steel or not. It would be wise for the iron-masters to keep a dozen chemists on high salaries, analysing for years, until the results amounted to thousands. Generally, they desire the results in a few days, and made as cheaply as possible. The results may be of no value for years, but valuable they will be; and if iron-masters care little for the future, we can only hope that this question is one which will be taken up by the nation, and that, for the sake of commerce, manufacturers, and that part of humanity which suffers from wrecked iron vessels, boiler explosions, and breakages of machinery, such inquiries shall be made as shall settle these questions for ever, although a century may be needed for the investigation.

ON
ENGLISH AND FOREIGN ALKALIMETRICAL
AND CHLORIMETRICAL DEGREES.*

By JOHN PATTINSON, F.C.S.

THE relations between English and foreign alkalimetric and chlorimetric degrees are but little known amongst merchants, chemical brokers, and others, who are in the habit of exporting large quantities of alkali, soda-ash, and bleaching powder; and it is a remarkable fact, that, even in many of the laboratories of our chemical works, these relationships are very imperfectly understood. It is a common mistake to suppose that the alkalimetric degrees of Decroizille represent percentages of carbonate of soda; then, again, both English and foreign chemists who are unacquainted with the usages of the soda trade, erroneously take for granted that the English soda test is based upon the most recently established atomic weight of soda—31.

Doubtless, the want of knowledge on this subject is owing to the almost entire absence from our chemical handbooks of all information on the matter. I am not aware of any English book which gives the value of Decroizille's degrees; and in very few English books treating on alkalimetry is there any mention of the use of the atomic number, 32, as a basis for the test for soda in the English soda trade. I have also found a similar want of information on the relation between French and English chlorimetric degrees, very few of our handbooks mentioning the French method of stating the value of a sample of bleaching powder.

As may be easily conceived, the want of information on these matters, in trades of such magnitude as our soda and bleaching powder trades, is a fruitful source of misunderstanding and dispute. It appears to me that our young Society, established in the midst of one of the great seats of these trades, is a fitting medium through which to diffuse the requisite information. With a view to further this object, I have made the necessary calculations, and arranged two comparative tables—one showing the relations between the amounts of soda, carbonate of soda, English degrees, and Decroizille's degrees; and the other, the relation between French and English chlorimetric degrees. I am indebted to M. Kuhlmann, of Lille (himself a large soda manufacturer), for the correct statement of the value of Decroizille's degrees. (See next page).

It is, doubtless, highly desirable, for the sake of scientific accuracy and uniformity, that the atomic weight of 31 for soda, instead of 32, should be adopted in England as a basis for the test for soda. It is, however, always difficult to alter trade usages, and there are good reasons why this one should not be hastily changed. It gives to the manufacturer an advantage of 0.65 of a per cent on a 50 per cent alkali—that is, an alkali testing 50 per

* Read before the Newcastle Chemical Society, January 28th, 1869.

COMPARATIVE TABLES
OF
ENGLISH AND FOREIGN ALKALIMETRICAL AND CHLORIMETRICAL DEGREES.

ALKALIMETRICAL TABLE.

Percentage of Soda.	Carbonate of Soda.	English Degrees.	Decroizilles' Degrees.	Percentage of Soda.	Carbonate of Soda.	English Degrees.	Decroizilles' Degrees.	Percentage of Soda.	Carbonate of Soda.	English Degrees.	Decroizilles' Degrees.
30.0	51.29	30.39	47.42	46.0	78.66	46.60	72.71	62.0	106.01	62.82	98.00
30.5	52.14	30.90	48.21	46.5	79.51	47.11	73.50	62.5	106.86	63.32	98.79
31.0	53.00	31.41	49.00	47.0	80.37	47.62	74.29	63.0	107.72	63.83	99.58
31.5	53.85	31.91	49.79	47.5	81.22	48.12	75.08	63.5	108.57	64.33	100.37
32.0	54.71	32.42	50.58	48.0	82.07	48.63	75.87	64.0	109.43	64.84	101.16
32.5	55.56	32.92	51.37	48.5	82.93	49.14	76.66	64.5	110.28	65.35	101.95
33.0	56.42	33.43	52.16	49.0	83.78	49.64	77.45	65.0	111.14	65.85	102.74
33.5	57.27	33.94	52.95	49.5	84.64	50.15	78.24	65.5	111.99	66.36	103.53
34.0	58.13	34.44	53.74	50.0	85.48	50.66	79.03	66.0	112.85	66.87	104.32
34.5	58.98	34.95	54.53	50.5	86.34	51.16	79.82	66.5	113.70	67.37	105.11
35.0	59.84	35.46	55.32	51.0	87.19	51.67	80.61	67.0	114.56	67.88	105.90
35.5	60.69	35.96	56.11	51.5	88.05	52.18	81.40	67.5	115.41	68.39	106.69
36.0	61.55	36.47	56.90	52.0	88.90	52.68	82.19	68.0	116.27	68.89	107.48
36.5	62.40	36.98	57.69	52.5	89.76	53.19	82.98	68.5	117.12	69.40	108.27
37.0	63.26	37.48	58.48	53.0	90.61	53.70	83.77	69.0	117.98	69.91	109.06
37.5	64.11	37.99	59.27	53.5	91.47	54.20	84.56	69.5	118.83	70.41	109.85
38.0	64.97	38.50	60.06	54.0	92.32	54.71	85.35	70.0	119.69	70.92	110.64
38.5	65.82	39.00	60.85	54.5	93.18	55.22	86.14	70.5	120.53	71.43	111.43
39.0	66.68	39.51	61.64	55.0	94.03	55.72	86.93	71.0	121.39	71.93	112.23
39.5	67.53	40.02	62.43	55.5	94.89	56.23	87.72	71.5	122.24	72.44	113.02
40.0	68.39	40.52	63.22	56.0	95.74	56.74	88.52	72.0	123.10	72.95	113.81
40.5	69.24	41.03	64.01	56.5	96.60	57.24	89.31	72.5	123.95	73.45	114.60
41.0	70.10	41.54	64.81	57.0	97.45	57.75	90.10	73.0	124.81	73.96	115.39
41.5	70.95	42.04	65.60	57.5	98.31	58.26	90.89	73.5	125.66	74.47	116.18
42.0	71.81	42.55	66.39	58.0	99.16	58.76	91.68	74.0	126.52	74.97	116.97
42.5	72.66	43.06	67.18	58.5	100.02	59.27	92.47	74.5	127.37	75.48	117.76
43.0	73.52	43.57	67.97	59.0	100.87	59.77	93.26	75.0	128.23	75.99	118.55
43.5	74.37	44.07	68.76	59.5	101.73	60.28	94.05	75.5	129.08	76.49	119.34
44.0	75.23	44.58	69.55	60.0	102.58	60.79	94.84	76.0	129.94	77.00	120.13
44.5	76.08	45.08	70.34	60.5	103.44	61.30	95.63	76.5	130.79	77.51	120.92
45.0	76.95	45.59	71.13	61.0	104.30	61.80	96.42	77.0	131.65	78.01	121.71
45.5	77.80	46.10	71.92	61.5	105.15	62.31	97.21	77.5	132.50	78.52	122.50

The first column contains percentages of soda, calculated on the correct atomic weight—31. These also represent what are known in France as Gay-Lussac's degrees.

The second column contains the amounts of carbonate of soda corresponding to the soda in the first column. Soda ash is sold in Germany, Russia, &c., by the percentage of carbonate of soda it contains.

The third column gives the corresponding percentages of soda according to the English test, which is based on the old atomic weight of soda—32—still retained as a trade custom in England.

The fourth column shows the corresponding degrees of Decroizilles' alkalimeter. These degrees represent the number of parts of monohydrated sulphuric acid (oil of vitriol) which can be neutralised by 100 parts of the sample under examination. Decroizilles' degrees are used in France and some other parts of the Continent.

NOTE.—In the commercial testing of samples of soda ash and alkali, all the soda neutralised by test acid is taken into account, and reckoned as soda in the mode of stating the results shown in the first and third columns, as carbonate of soda as shown in the second column, and as degrees as shown in the fourth column.

CHLORIMETRICAL TABLE.

French Degrees.	English Degrees.	French Degrees.	English Degrees.	French Degrees.	English Degrees.	French Degrees.	English Degrees.	French Degrees.	English Degrees.	French Degrees.	English Degrees.
63	20.02	74	23.51	85	27.01	96	30.51	107	34.00	118	37.50
64	20.34	75	23.83	86	27.33	97	30.82	108	34.32	119	37.81
65	20.65	76	24.15	87	27.65	98	31.14	109	34.64	120	38.13
66	20.97	77	24.47	88	27.96	99	31.46	110	34.95	121	38.45
67	21.29	78	24.79	89	28.28	100	31.78	111	35.27	122	38.77
68	21.61	79	25.10	90	28.60	101	32.09	112	35.59	123	39.08
69	21.93	80	25.42	91	28.92	102	32.41	113	35.91	124	39.40
70	22.24	81	25.74	92	29.23	103	32.73	114	36.22	125	39.72
71	22.56	82	26.06	93	29.55	104	33.05	115	36.54	126	40.04
72	22.88	83	26.37	94	29.87	105	33.36	116	36.86	127	40.36
73	23.20	84	26.69	95	30.19	106	33.68	117	37.18	128	40.67

The French degrees represent the number of litres of chlorine gas, at 0° C. temperature (32° Fah.) and 760 m.m. barometric pressure (29.92 inches), which can be obtained from 1 kilogramme of the sample of chloride of lime (bleaching powder) under examination.

The English degrees represent the actual percentage of available chlorine contained in the sample under examination. This mode of stating the results is used in Germany, Russia, America, &c.

cent by the English test, only contains 49.35 per cent of actual soda. In the London market, it is also an established custom in the alkali trade to pay for parcels of goods only on the whole degrees, and not on the fractions, so that an alkali which contains 50.9 per cent of soda, by the English test, is invoiced and paid for as only containing 50 per cent. It will thus be seen that the disadvantage to the manufacturer of the latter custom just about counterbalances the advantage gained by the former. It would, obviously, be unfair to alter one custom, and leave the other in force. Another trade custom, affecting the chemical manufacturer to his disadvantage, is that of assuming the amount of peroxide of manganese contained in a sample of manganese ore to be equal to the two atoms of carbonic acid evolved when the ore is tested by the ordinary oxalic acid process. These peculiar trade customs in analysis are a very frequent cause of misunderstanding and annoyance, and it would be well if they could be abolished in favour of methods which all chemists admit to be correct, according to the present state of chemical knowledge. I am of opinion, however, that these changes can only be effectually made by the chemical trade itself, and I recommend the subject to the consideration of the Alkali Makers' Association. But so long as these trade customs continue in use it is desirable that exact information as to their nature, should be attainable by all persons interested in the trade. The table here given will help to do this, so far as relates to the English soda test.

In making the calculations for the chlorimetrical table, I have adopted the combining number of 35.46 for chlorine, as given by Stas and Marignac, and have taken 0.08961 gramme as the weight of a litre of hydrogen at zero centigrade and 760 m.m. pressure. The weight of 1 litre of chlorine, at the same temperature and pressure, is, therefore, 3.17763 grammes.

ON THE IMMEDIATE ANALYSIS OF DIFFERENT VARIETIES OF CARBON.

By M. BERTHELOT.

(ABSTRACT)

THIS method consists of oxidising carbon at a low temperature and examining the product obtained. Under these conditions

1st. Diamonds, whether black or of the common kind, are not sensibly oxidised even by repeated and prolonged treatment.

2nd. The different varieties of amorphous carbon are completely transformed into humoid acids of a yellowish brown colour, soluble in water. The properties of these acids vary according to the kind of carbon which produces them.

3rd. The different varieties of true graphite are changed into corresponding graphitic oxides; the properties of these oxides also vary according to the nature of the graphite whence they are obtained, but all are characterised by their insolubility and especially by their capability of being quickly decomposed, with deflagration, by the action of heat.

This is the mode of operation:—Mix with the powdered carbon five times its weight of chlorate of potassium previously pulverised, and gradually form into a sort of paste with fuming nitric acid; leave it for some hours in a small open flask, and then heat it for three or four days without intermission to about 50° or 60° C.; after this dilute it with water and wash by decantation with tepid water until the salts of potash are dissolved. It is generally necessary to repeat the process five or six times, or even more, in order to produce either of the results above mentioned.

The different varieties of carbon may thus be distin-

guished by studying the products of their oxidation. I believe this will also lead to the separation of graphites and amorphous carbons into several distinct groups, but this subject demands further inquiry. I propose henceforth to reserve the name of *graphite* exclusively to carbons which furnish a graphitic oxide, thus avoiding former ambiguities; the new mode of analysis is applicable not only to pure carbon but also to the mixed varieties.

1st. In the case of a mixture of amorphous carbon and diamond, the amorphous carbon is entirely dissolved after a few repetitions of the process, while the diamond remains unaltered.

2nd. In a mixture of graphite and amorphous carbon, the amorphous carbon is completely dissolved after repeated treatment, whilst the graphite gives rise to an insoluble graphitic oxide of a yellow or greenish yellow colour, decomposable with deflagration. The graphitic oxide may be decomposed, as will be shown, in such a way as to cause the disappearance of the whole of the carbon.

3rd. In a mixture of diamond, graphite, and amorphous carbon, the amorphous carbon is entirely dissolved, leaving a mixture of graphitic oxide and diamond; this cannot be dissolved by solvents, but the diamond may be isolated as follows:—

Dry the mixture, then heat it in a tube closed at one end; the graphitic oxide is destroyed, leaving pyrographitic oxide; this reoxidised by chlorate of potash and nitric acid, forms soluble products, and a proportion of graphitic oxide much smaller than that first destroyed.

On decomposing this new graphitic oxide by heat, and then reoxidising the new pyrographitic oxide, only traces of graphitic oxide will be discovered. After three or four operations, the whole of the graphitic oxide will disappear, leaving only the diamond. Certain hard and crystalline powders formed by silicates or silica, and which occasionally occur as the last residue, must not be confounded with the diamond powder. The employment of fluorhydric acid, combined when needful with water and concentrated nitric and sulphuric acid, will cause the entire disappearance of this kind of residue.—*Comptes Rendus*.

Absinthe.—It appears that until 1864 the belief that there was nothing injurious in absinthe except the alcohol was general enough. In that year, however, a mad doctor named Marcé communicated a paper to the Academy of Sciences, in which he demonstrated that the essence of wormwood was contained in the liquor called absinthe in the proportion of twenty grammes of essence to 100 litres of alcohol, and argued that this essence had a peculiarly injurious effect on the brain. In 1867 a petition was presented to the Senate, praying that the sale of absinthe might be absolutely forbidden. Nothing came of it; and now the "question of absinthe" has been once more brought forward by two physicians, MM. Magnan and Bouchereau, who, for the first time, have made regular scientific experiments with the questionable stuff. The object of the experimentalists was to show what the effect of pure alcohol would be on a guinea-pig, and what the effect of absinthe. With this view they placed a guinea-pig under a glass case with a saucer full of essence of wormwood by his side, another guinea-pig being placed under another glass case with a saucer full of alcohol. The guinea-pig, who, so to say, was being "treated" with absinthe, sniffed at the fumes, and for a few moments seemed, like the absinthe drinker before mentioned, "supremely happy." Gradually, however, he became heavy and dull, and at last fell on his side, agitating his limbs convulsively, foaming at the mouth, and presenting all the signs of epilepsy. The same epileptic symptoms were manifested on the part of a cat and a rabbit who, in a similar manner were made to inhale the fumes of absinthe. On the other hand, the guinea-pig who was forced to get intoxicated with pure alcohol behaved like an ordinary drunkard. He became lively, then reeled about, and at last lay down and fell into a heavy sleep.—*Pall Mall Gazette*.

ON THE
CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(ADAPTED TO A JUVENILE AUDITORY),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN,
(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, Esq., M.B., F.R.S.

(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE IV.

CARBONIC GAS, OR FIXED AIR.

(Continued from p. 101.)

Here is a jar full of carbonic gas, the presence of the gas being shown by the immediate extinction of a lighted taper; the jar is apparently empty, but in reality it is full of gas. If I wanted to empty it of any liquid it might contain, there are several methods to which I might have recourse; of course the most obvious one would be simply to pour it out. I will first see if I can pour anything out of this jar on to the taper. [The jar was tilted over a lighted taper, which was at once extinguished by the invisible gas.] You see we have poured something out. We will try it in another way. Here is a bottle of lime-water, and we will see whether we can pour into it any gas from our jar. I just hold our apparently empty jar over the lime-water, and then shake up the lime-water, and you see it is at once converted into a mixture of chalk and water; this is the most usual way of getting a liquid out of a jar. There is another method, to which we may very easily resort. I will pour out some of the gas upon the candle in another way; I first pour some of it into a beaker, and then from the beaker on to the candle, which is thus at once extinguished. This is another illustration of the mode of getting this heavy gas out of the jar—by simply pouring it. Now we will adopt some other methods. I again light the candle, and, instead of pouring out the gas, I will bale it out. I take a glass cup, and introduce it into the jar of carbonic gas, thus abstracting a quantity of it, which I will pour from the cup into the lime-water; I then shake up the lime-water, and you see that I have in this way actually conveyed some of the gas into the bottle of lime-water. Now I will try whether some more of the gas can be baled out from this jar, and a candle extinguished with it. I fill the cup with the gas, and pour it upon the

candle; and you see that at once the flame goes out.

If I wanted to empty out of a large jar like this, any liquid it might contain, I could, as I have reminded you, pour out the liquid as I did at first, or I could bale it out; but there are other methods still which might be employed. You must all be familiar with the syphon, and you have, no doubt, seen it in use in the streets, in front of public houses, for the purpose of drawing off spirits from the casks into the large measures. Now let us try whether we can in the same way remove any carbonic gas from this jar; we will first fill our syphon, and then see if we can syphon off the gas. I apply the syphon; and you perceive that, by its means, we can cause the gas to flow upon the candle, and at once put it out. I now take a little lime-water, and upon this I allow the syphon to empty itself for a few instants. [After a short pause]—It has gone on long enough, I have no doubt. I therefore place the stopper in the bottle of lime-water, and, on shaking it up, the lime is immediately converted into chalk. I have syphoned off the gas, and this proves to you that it is heavy, and can be treated like a liquid; we can either pour it out, bale it out, or syphon it out.

Now let me give you one or two further illustrations of the weight of carbonic gas, and for this purpose I will take it as it is contained in soda-water. Here is an empty bottle,—that is to say, a bottle containing nothing but air; I will pour into it some clear lime-water, and then endeavour to act upon that lime-water by the gas evolved from our bottle of soda-water, and at the same time I shall have an opportunity of showing you the weight of the gas. I have already once or twice put out a candle by the gas evolved from soda-water, and this experiment I intend to repeat; but this time I will pour the gas upon the candle, and so show you its weight. When I extinguished the candle by means of the gas from soda-water, we had not considered the weight of the gas. I just open the soda-water bottle, carefully, and first I will try the action of the gas upon the lime-water. I take a funnel, and into it I pour some of this carbonic gas that it may descend into the lime-water. I simply pour the gas, without any of the water which is contained in the bottle, and you see that we have formed a reasonable amount of chalk by means of the gas that we have thus poured upon the lime-water. [The lime-water was shaken, and became turbid, indicating the presence of carbonic gas in the bottle.]

Now let me call your attention to another mode of getting out this gas, and for that purpose I will use this larger cylinder, which is now being filled with the gas from the supply

* Reported verbatim, by permission of the Author, for this Journal.

down stairs; we will ascertain whether the jar is full. You see it is so, for on introducing the taper, the light is at once extinguished. You know that another very common way of emptying a large vessel of water is to use a tap. Now here is our large jar really full of gas, although it looks as if it were empty. I just close the tap by putting my finger upon it. We will first of all draw off a little of the gas over a bottle of lime-water, into which I now let some of the gas run. I have no doubt that the bottle now contains sufficient for our purpose. I shake it up, and you see we get a similar result to what we did with the soda-water. I will take another bottle, and this time, instead of allowing the gas to run directly into the bottle, I will let it run into the beaker so as to fill it, and then I will pour its contents into the bottle. I hold the glass beaker carefully under the tap so as to catch the gas, and now that it is sufficiently full I close the tap with my finger, and pour the gas contained in the beaker into the bottle. I shake up the bottle, and here again you see our clear lime-water is converted into a mixture of chalk and water. I will now allow the gas from the tap of the jar to flow upon a candle, and you see that as it does so the flame is at once extinguished by it. Here is another candle, upon which I will also let the gas pour down, and I may call your attention at the same time to the force with which it issues from the jar. You see that in this instance it blows out the flame of the candle before completely extinguishing it in its usual way. I will now allow the carbonic gas to fall upon a flame of ordinary coal gas, and in this case also the flame is extinguished. Now I will endeavour to catch some of this gas by letting it pour into a beaker, and then try to pour it from the beaker on to a candle. You see our vessel was completely full, for when I pour the gas on to the candle the flame immediately goes out. I will now give you another illustration of the weight of the gas. In this instance, instead of bringing the candle to our barrel, I will bring the barrel to the candle. Having done so, I remove my finger from the tap, and you see the light is at once entirely extinguished. We will try the same experiment with a gas jet. I bring the barrel of gas to the jet, and when I remove my finger the flame is at once blown out. The fact is, the gas is pouring out from this tap with considerable force, as is proved by its action on the flame. Again, I collect some of the gas in a beaker, and wait until there is reason to believe that the vessel is full. Having now got sufficient gas for our purpose, I empty the beaker on to some lime-water, and on shaking up the lime-water you see that a quantity of chalk is formed.

So much, then, for these illustrations of the

way in which this heavy gas may be got from a vessel by all the ordinary processes that are employed for getting water out of a vessel. I refill our large jar for another purpose. You will remember that at a former lecture we had a cylinder apparently full of only one liquid—water—though in reality it contained two; the lower liquid was water, and the upper one was spirit, floating upon the water. You may perhaps recollect the means by which we ascertained the line of demarcation between the two fluids. We dropped in a piece of wax, which sank through the spirit; but when it came to the surface of the water, it immediately floated upon it, showing us the height to which the water reached. Now I can show you a somewhat similar experiment with this gas in this large jar, and you will see to what height the carbonic gas reaches. Instead of taking a piece of wax as I did when we were experimenting with the water and spirit, I will take a balloon—one of those toys with which we are all familiar. You see this balloon will not fall very quickly through the air, but still it would fall down to the ground in a moment or two if we allowed it. [A small india-rubber balloon distended with air was placed within a large cylinder, partially filled with carbonic gas. The balloon sank a short distance down the cylinder, and there floated on the surface of the invisible carbonic gas, indicating the height of the gas in the cylinder.] You see very clearly that the balloon floats on the surface of the carbonic gas just as the piece of wax did on the surface of the water. If I knock the balloon down through the carbonic gas, it will not keep down, but rises to the surface of the gas. I will try one more experiment illustrative of the weight of this gas, to bring these experiments to a conclusion. I will now put into the jar another balloon, heavier than the former. It will gradually sink, and thereby indicate to us the pouring out of the gas. You will see from the fact of the balloon sinking lower and lower, that the jar is getting more and more empty. The gas from this jar is gradually pouring out into the cylinder below, and this we can prove by inserting a lighted taper into the lower vessel. The taper goes out.

Spirit From Lichens.—Mr. Stenberg has just made some experiments with a view of converting the cellulose of certain species of lichens, which are very common in Sweden, into glucose and alcohol. The species *Cladonia rangiferina* yielded the best results. Boiled for twelve hours with water containing $12\frac{1}{2}$ per cent of sulphuric acid, this lichen yielded 68 per cent of glucose; fermented and distilled, the spirit obtained was found to possess a peculiar flavour of almonds (hydrocyanic acid?), but was not otherwise disagreeable; the glucose isolated and examined had a very disagreeable flavour. Many lichens are poisonous; and all, especially those met with in northern climes, contain a very bitter tasting principle.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL
SOCIETY.*Ordinary Meeting, January 26th. 1869.*R: ANGUS SMITH, Ph.D., F.R.S., Vice-President, in the
Chair.*"On Microscopical Examination of Dust,"* by J. B. DANCER, F.R.A.S.

The author stated that he had made some microscopical examinations of dust collected in June, July, and August last, and also of the particles contained in the rain water after the long drought. He had intended to bring these observations before the Society in a complete form, but has not hitherto found time to do so. He proposed to carry on observations during every month in the year, for the purpose of recording the average amount of solid matter deposited on a given area, and also as far as possible to ascertain the character of the deposits. The observations so far have shown, as might have been expected, that the dust in various localities, at different altitudes, and under other varying conditions, contained particles differing in magnitude, appearance, and quantity for the same superficial area. In every instance molecular activity was abundant, but the animal life was very variable in amount, the largest number of moving organisms being in the dust collected at the lowest points—this was about five feet above the surface of the earth. This dust also contained the largest proportion in magnitude and quantity of vegetable matter. These observations also show that in thoroughfares where there are many animals engaged in the traffic, the majority of the light dust, which when disturbed reaches the average height of five feet, or about the level of a foot passenger's mouth, consists of a large proportion of vegetable matter which has passed through the stomachs of animals, or which has suffered partial decomposition in some way or other. This is not an agreeable piece of information, but it is a fact. It shows the necessity, in a sanitary point of view, of the streets being well watered before the scavengers are allowed to commence operations; otherwise the light dust is only made to change its locality, and is not properly removed. It is not pleasant to contemplate the possibility of germs of disease being wafted along with this decaying matter and inhaled by those whose condition might be favourable for its development. The author hopes to bring the details of these observations before the Society at some future time.

MICROSCOPICAL AND NATURAL HISTORY SECTION.

*February 1st, 1869.*J. B. DANCER, F.R.A.S., President of the Section, in the
Chair.Mr. JOHN BARROW read the following note "*On a Comparative Analysis of English and Aleppo Galls.*"

When Mr. Sidebotham brought before the notice of this Section the subject of the large increase in the production of galls upon the oaks in this country, he expressed a wish that some member would make an analysis of them so as to confirm his experiments as to their value.

I requested Mr. Watson Smith, F.C.S., who is at present engaged in my laboratory, to undertake this task, and have pleasure in submitting to the Section his results. In order to make the analysis of practical value I suggested to him that he should examine both the English and Aleppo galls, and he has therefore experimented on the best sample of Aleppo galls I could procure and English galls obtained fresh from Cheshire.

The process used in both cases was that of Pelouze, viz., by crushing with ether; and, although this process is not absolutely accurate, it is the best one that Mr. Smith or myself could discover.

The results are—

	Aleppo Galls.	English Galls.
Gallo-tannic acid	61.65	26.71
Gallic acid	1.60	trace only
Woody fibre	15.68	47.88
Water	12.32	20.61
Colouring matter and loss ..	8.75	4.80
	100.00	100.00

Probably more gallic acid would be found if the galls had been gathered a longer time.

This analysis confirms Mr. Sidebotham's opinion of the value of the English galls, but does not make them quite as valuable as he puts them.

NEWCASTLE CHEMICAL SOCIETY.

THE third general meeting was held on Feb. 24th, Mr. GLOVER, in the Chair.

Dr. SCHWARZ read a paper "*On the Toxicology of the Cyanides.*" On the motion of the Chairman a vote of thanks was awarded to him.

Dr. LUNGE read, for Dr. CLEMM, a description of "*A New Volumetric Process for Sulphuric Acid and Sulphates.*" The method, which is of course incompatible with the presence of certain radicles, may be summed up thus:—Accurately neutralise, precipitate by excess of standard BaCl_2 , then add excess of standard Na_2CO_3 , make up to, say, 200 c.c., filter off 100 c.c., and litrate the unremoved carbonate.

Dr. LUNGE described at some length the modifications necessary in the case of pyrites, and cited test analyses which had given quite satisfactory results.

GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION).

A meeting was held in the Society's rooms, Andersonian Buildings, on Monday, the 1st inst, at eight o'clock in the evening, Dr. W. Wallace in the Chair.

One member was balloted for and declared duly admitted, and two candidates were proposed.

A lecture was delivered by A. S. HERSCHEL, Esq., B.A., F.R.A.S., "*On the Methods and Recent Progress of Spectrum Analysis.*" We shall give this lecture, either in full or in abstract, in as early a number as possible.

FOREIGN SCIENCE.

PARIS, MARCH 3, 1869.

Action of Iodine on Sulphides.—Alloys of Copper and Tin.—Union of Free Nitrogen and Acetylene and Direct Synthesis of Hydrocyanic Acid.

MM. FILHOL and MELLIER have published a research upon the action which iodine exerts upon various sulphides. The action which iodine exerts on alkaline sulphides is already known; it consists in the displacement of the sulphur by iodine: the manner in which iodine acts upon insoluble sulphides is, however, but imperfectly known. Both natural and artificial sulphides were operated upon, and iodine was brought in contact with these bodies, sometimes in a dry state, and at others in solution in alcohol, ether, sulphide of carbon, chloroform, &c. The action is generally rapid in the case of artificially prepared sulphides, in the form of precipitates; it is sometimes accompanied by great heat, reducing a portion of

the iodine to vapour. For this reason, it would probably be dangerous to mix sulphides and iodine dry, or in any quantity. Natural sulphides are attacked more slowly, but the elevation of temperature is observable in certain cases. The same effect is produced when iodine in a solution of iodide of potassium is made to act upon the sulphide. In certain cases, the reaction is complicated by the presence of the solvent and the easy decomposition of the iodide.

In a note communicated to the Academy by M. Riche, the following facts concerning the alloys of copper and tin are given. The question of density is first taken. Some determinations were made upon bars of these metals, weighing from 50 to 60 grms., but the results obtained were unimportant, owing to the great difference which exists in these alloys. The same metals, reduced to fine powder, were afterwards operated upon, when it was observed that the contraction increases very regularly from the very rich alloy in tin to the mixture SnCu_2 , and from this point it increases suddenly, arriving at a maximum, when the copper and tin are united in the relation of 1 to 3. The density diminishes from this point, then rises again nearly regularly; the density of the richest copper alloys is inferior to the mixture SnCu_3 , which only contains 62 per cent of copper. Besides, this alloy may be distinguished from all the others by its properties; it is brittle enough to be pounded in a mortar, and forms crystals of a bluish tint, not resembling in the least either copper or tin. M. Riche gives a number of formulæ, expressing the composition of the definite compounds which copper forms with tin and their properties. Referring to liquefaction, he then observes, "In order to separate these alloys, the mass should be moved about when becoming solid, to separate the crystals whilst forming." The fusibility of these alloys has been determined by the thermoelectric pyrometer. M. Riche has operated comparatively with these alloys, and with metals whose fusing points have been settled by various experimenters. Numerous determinations show that the solidification of the alloys SnCu_3 and SnCu_4 takes place at a temperature somewhere between the fusion point of antimony and the boiling point of cadmium.

M. Balard has presented a note from M. Berthelot, in which the union of free nitrogen and acetylene, and the direct synthesis of hydrocyanic acid are explained. Free nitrogen is distinguished by its indifference to most other bodies; it is only when under the influence of the electric spark that this indifference can be successfully combated, either with oxygen, as in Cavendish's celebrated experience, or with hydrogen, which leaves traces of ammonia. A new reaction of the same class is now to be noted, namely, the direct union of free nitrogen with acetylene, in which case hydrocyanic acid is found. Acetylene is a hydrocarbon possessing remarkable chemical activity. Formed by the direct synthesis of the elements, it may afterwards be united with nascent or even free hydrogen to form olefiant or ethylene gas at first, and then hydride of ethylene; free acetylene may be combined directly with nascent oxygen to form oxalic acid. The metals of the alkalies attack it easily. This same chemical activity is also servable between acetylene and nitrogen in the free state. Thus, when a series of induction sparks is made to traverse a mixture of these two pure gases, the characteristic odour of hydrocyanic acid is soon perceived; the amount may also be estimated by the ordinary processes. In the circumstances just mentioned, the formation of hydrocyanic acid is accompanied by carbon and hydrogen, engendered by a distinct, but simultaneous, decomposition of acetylene. This complication may be avoided by adding to the mixture, beforehand, a sufficient volume of hydrogen, for example, ten times the volume of the acetylene: no deposit of carbon is then observed, and the reaction corresponds with the following equations:— $\text{C}_4\text{H}_2\text{N}_2 = 2\text{C}_2\text{HN}$. In other terms, the acetylene and nitrogen combine in equal volumes and without condensation. Cyanogen and hydrogen are combined in the

same manner:— $\text{C}_4\text{N}_2 + \text{H}_2 = 2\text{C}_2\text{HN}$. The formation of hydrocyanic acid in the reaction of nitrogen upon acetylene commences rather rapidly, but very soon slackens. In an experiment made upon 160 c.c. of a mixture formed of 10 volumes of acetylene, 14.5 nitrogen, and 75.5 hydrogen, after passing sparks for an hour and a half, 8 c.c. (10 milligrammes) of hydrocyanic acid were obtained without any deposit of carbon: when the action slackens it may be started afresh by removing the hydrocyanic acid by means of a moistened fragment of potash, and then exposing the purified gas to the influence of sparks. The action always ends by slackening, in consequence of the gradual dilution of the acetylene.

By following up the experiment, a certain volume of acetylene may be made to disappear by placing previously in the epruvette a drop of a strong solution of potash, to absorb the hydrocyanic acid as fast as it is formed. In this manner 5-6ths of a known volume of acetylene may be changed into hydrocyanic acid. M. Berthelot explains the failure of the sixth part by the inevitable reaction of the vapour of water, which forms carbonic oxide and carbonic acid. This experiment required from twelve to fifteen hours' sparks. More than half of a known volume of nitrogen was changed into hydrocyanic acid in presence of an excess of acetylene; the rest would probably disappear after a much longer time. The presence of the hydrocyanic acid which is already formed, stops the reaction. This circumstance is easily explained. The mixture of hydrocyanic acid and hydrogen, traversed by a series of sparks, produces acetylene very quickly. Under the influence of the sparks, a certain variable equilibrium, according to the proportions, exists between hydrogen, nitrogen, acetylene, and hydrocyanic acid.

Pure nitrogen, under the prolonged influence of sparks, will not combine either with hydrogen or acetylene. Another interesting phenomenon occurs in the transformation of free nitrogen into hydrocyanic acid by union with acetylene. M. Berthelot states that all hydrocarbon compounds produce acetylene under the influence of sparks; thus it appears that nitrogen, mixed with whatsoever hydrocarbon vapour, should also form hydrocyanic acid. M. Berthelot has verified this fact with olefiant gas and with hydride of hexylene (from petroleum). In operating in presence of potash, Prussian blue is found among the products, after two or three minutes' sparks, an easy and sensitive test for nitrogen. M. Berthelot states in conclusion with reference to the chemical action of electricity that he has already observed that hydrocyanic acid is a body formed with absorption of heat from its elements, he now shows that hydrocyanic acid may also be produced by the direct union of carbide of hydrogen and nitrogen under the influence of the electric spark.

CORRESPONDENCE.

ON PHOSPHORUS IN IRON AND STEEL.

To the Editor of the Chemical News.

SIR,—I am sorry to see that Dr. Paul in replying to my letter on the above subject, has merely perpetrated a few common-place sarcasms, which cannot throw any light upon the chemical relations of phosphorus to iron, and which were certainly not called for by any remarks of mine.

That the fallacy I referred to does exist somewhere outside of my imagination, can be seen at once by reference to the CHEMICAL NEWS of Jan. 29th, p. 58. Anybody who refers to that report—the accuracy of which Dr. Paul does not question—will see that he commences with the statement that "It is generally considered that very small quantities of phosphorus in malleable iron and steel are most prejudicial to the quality of the metal,"

and that "quite recently an eminent metallurgist has stated, as a fact, that much less than 0.3 per cent of phosphorus produces a decided and injurious effect upon steel." He then proceeds to controvert that statement, and bases his controversion on the fact that "he had recently had an opportunity of testing the truth of this conclusion by determining the phosphorus in some samples of iron and steel," &c. He then states *how* the quality of these seven bars of iron and two bars of steel was tested—viz., by Mr. Kirkaldy's tensile strain and extension tests; he gives Mr. Kirkaldy's figures, and those of his own analyses, and finding that the iron and steel containing so much phosphorus stood these mechanical tests so satisfactorily, he "*therefore* thinks himself justified in asserting that the commonly-received opinion on this subject does not always represent the truth."

The object of my letter was to show that this reliance upon the gradually applied tenacity and extension tests is fallacious; that these tests, though of great practical value in determining some points, do not detect the special mischief which phosphorus, in small quantities, does to iron and steel. It was quite evident, from the discussion which followed the reading of Dr. Paul's paper in the Chemical Society, and from expressions of opinion recently made in other places, that Dr. Paul is not the only one who has been misled by the application of these tests, which, as I explained, may even represent all kinds of malleable iron, and some kinds of steel, as actually improved by the addition of a little phosphorus, on account of the increased tenacity of a peculiar kind which it confers.

When I referred to my own position as chemist to one of the largest and most important iron-works in Europe, it was not, as Dr. Paul insinuates, with the view of self-exaltation, but to indicate, that, in pointing out a mistake made by him and Dr. Miller, I was merely correcting a technical error, which any chemist, not having such daily and special "opportunities of comparing the results of chemical analysis with the verdicts of practical trials," would be liable to make.

I confined myself to a general statement of the facts (Dr. Paul seems to regard brittleness, tenacity, hardness, cold-shortness, &c., as only "opinions") best known concerning the special characters of the deterioration produced by phosphorus, simply because my letter had already made a sufficient demand both upon your columns and my time; but if the subject is considered sufficiently interesting, I shall be happy to take an early opportunity of supplying you with some illustrations of the special instances from which the general inductions are derived.—I am, &c.,

W. MATTIEU WILLIAMS.

The Laboratory, Sir John Brown and Co., Sheffield.

[Our correspondent will confer a favour on our readers by communicating the valuable information he so kindly volunteers.—*Ed. C. N.*]

SPURIOUS GUANO.

To the Editor of the Chemical News.

SIR,—Dr. Paul, in your last impression, has a letter with the above heading, containing, as I think, a very unjustifiable attack upon the manufacturers of a manure called "Biphosphated Peruvian Guano." He says, "It is not Peruvian guano at all;" that "it more nearly resembles superphosphate of lime;" that "it is not worth one-half the price asked for it;" that "it contains not much more than one-third the quantity of ammonia in Peruvian guano," and that it is a trashy manure. Surely Dr. Paul cannot be very familiar with the subject on which he writes, when he ventures to make these statements? I have no desire to speak harshly of Dr. Paul, who may be acting under some misapprehension, or to question the propriety of admitting into your valuable journal a letter intended to be very damaging, without some inquiry, when

at least a week must pass before any reply can be made, but, as I have been frequently consulted upon the subject of this manure and its manufacture, and have made repeated analyses of the products, I think it necessary to say a few words in answer to Dr. Paul. The works are freely open to me, and I have constant opportunities of watching every stage of the processes, but, whilst I have neither the right nor the inclination to disclose the methods adopted, I may say that they are perfectly simple and straightforward; there is no mystery either in the name or in the composition, the former pretty nearly indicating the latter; and in reference to its composition, it does actually contain more than 50 per cent of fine Peruvian Government guano; more than 24 per cent of phosphate of lime, of which 21 per cent, at least, is soluble; 6 per cent of alkaline salts; and 7 per cent of ammonia. Dr. Paul says there is no Peruvian guano at all, and that this is a "trashy manure." Dr. Voelcker, Dr. Anderson, Professor Way, Mr. Sibson, and myself, differ with him on all points, and, as I cannot ask you to include their opinions at length in my letter, I beg to refer to your advertising columns for their analyses in detail, to their reports upon the value of the manure for all purposes.—I am, &c.,

G. H. OGSTON.

22, Mincing Lane, E.C., March 2nd, 1869.

To the Editor of the Chemical News.

SIR,—With reference to a letter from Mr. B. H. Paul, which was contained in your last week's number, Mr. Ogston has informed us that he has thought it well to make some reply to Mr. B. H. Paul, and we will, therefore, only ask your readers' attention to the testimony borne to the value of this manure by the best authorities on agricultural chemistry, contained in their published analyses and reports, and inserted in your present number as an advertisement, itself an answer most complete to anything Mr. B. H. Paul may say.

We may add that we immediately commenced proceedings at law against Mr. B. H. Paul, for the statements contained in his letter.—We are, &c.,

REES AND CO.,

32, King William Street, E.C., March 2nd, 1869.

MISCELLANEOUS.

The Presidency of the Chemical Society.—At the meeting of this Society, held last evening, it was announced from the chair that Dr. Frankland, who had been nominated by the Council for election to the Presidency, had been compelled to decline that honour, owing to his present engagements rendering him unable to fulfil the duties. The subject is anxiously occupying the attention of the Council, and it is expected, before the next meeting, that a new balloting list for the election of Officers will be forwarded to the Members. The Council's list for the election of the other Members of Council stands as follows:—E. Atkinson, Ph.D., J. L. Bell, E. T. Chapman, W. Crookes, F.R.S., D. Forbes, F.R.S., D. Hanbury, F.R.S., A. Matthiessen, Ph.D., F.R.S., E. J. Mills, J. Prestwich, F.R.S., Maxwell Simpson, Ph.D., F.R.S., A. Voelcker, Ph.D., C. Greville Williams, F.R.S.

A New Element.—In our next number will be given a preliminary notice of a new element, discovered by means of spectrum analysis.

Gas Examiner for the City of London.—At a meeting of the Court of Common Council held on Thursday, Feb. 25th, the report of the Gas Examiner Committee was read, from which we learn that Mr. Heisch, F.C.S., and Dr. Whitmore are recommended as duly qualified for the office; and it is left for the Court to select one of these two well-known gentlemen. The report of the committee was carried almost unanimously.

How to Preserve Sodium Untarnished.—Many teachers, particularly in our high schools, have sodium preserved in the usual way, under naphtha. But the beautiful metallic lustre is not seen under these circumstances; and if the metal is taken out and a fresh cut made, this only shows the lustre for an instant. By the following artifice the metallic appearance of sodium may be permanently exhibited:—Take two test tubes, one a little smaller than the other, so as to slip into the latter without leaving much space between the two glass walls; put some carefully cleaned sodium in the wider tube, insert the more narrow tube, having previously given a thin coating of beeswax to the upper part of this latter, then gently heat the whole on a sand bath. The sodium will fuse, and by a gentle pressure, the inner tube is pressed down, so as to force the fused metal over a large surface between the two tubes, while the air is totally excluded by the beeswax. I have kept sodium for more than six months in this way, and it is now as bright and brilliant as when first put up.—*Prof. Gustavus Hinrichs, in the Scientific American.*

Discovery of the Weight of Air.—The following extracts from a letter addressed to us by the Abbé A. Hamy will be read with interest:—It has long been asserted that, before Galileo's experiment in 1643, the weight of air had not been demonstrated. However, many learned men, both of former times and of the present century, acknowledge that Aristotle attempted to demonstrate this important fact, while, at the same time, they are unanimous in declaring that the means employed by him were inadequate to the end he wished to accomplish. The honour of this great discovery is now yielded incontestably to Galileo, and what chance I shall stand of restoring the glory of it to the philosopher appears doubtful; but my conviction is, that he has a right to it, although his opinions on the nature of gravity differ from those of modern scientific men. In "De Cælo," lib. 4, we read:—"Suo enim in loco, gravitatem habent omnia præter ignem. Signum cujus est, utrem inflatum plus ponderis quam vacuum habere." "In their own medium, all bodies except heat, have weight; the proof of which is, that a leathern bottle weighs more when filled with air than it does when empty." It was, I believe, on this experiment that Aristotle founded his assertion of the gravity of air; and the only ground on which men of science based their opinion that the merit of the discovery was not due to him was, that in endeavouring themselves to test the truth of this assertion, many of them failed to detect any difference in weight between a bladder filled with air and one entirely empty. Such were the arguments used till the time of Galileo; then, by the exact measurement of the gravity of air, the failure of Aristotle's experiment could be accounted for; and, during the present century, in all elementary books in which the barometer is mentioned the vain attempt of Aristotle to measure the real weight of air is also spoken of. But it appears to me, that the arguments used by the philosopher's enemies fail to prove what they really intend. Of course they are right if they can demonstrate that he experimented with air at the same pressure as that of the atmosphere. But what grounds have they for such an opinion? Is it that they attribute to Aristotle what are, in reality, the failures and mistakes of his followers? We have, on the one side, the clear assertion that all bodies except heat, possess weight; and, on the other, Aristotle furnishes us with a process for the verification of this statement, which consists in weighing, not an extensible bladder, but an almost inextensible leathern jar successively full and empty of air. Now what conclusion are we to arrive at from such premises? That it is impossible to succeed? Or might it not be more correct to say, that by a process the details of which have not been transmitted to us, Aristotle himself succeeded in proving the gravity of air, while the attempts of his followers to do the same resulted in failure? For myself, I believe that the great philosopher, by means of a blow-pipe, confined in his leathern jar more air than it would

contain at the normal pressure; and, after weighing it, first empty and then full, he found such a difference that he could positively assert the gravity of air. In these days, when *à priori* arguments are so decried, we may be allowed to dissent from a similar reasoning which would rob antiquity of its glories. Therefore, instead of saying, "Although Aristotle stated that air was heavy, he tested it by a wrong process, which tended rather to prove the contrary," it would be more just to say, "Although Aristotle made use of a process which, at first sight, appears a wrong one, yet, as we find that by the supposition of compressed air he might succeed, we conclude that he discovered the truth, since it was he who asserted the fact."

NOTES AND QUERIES.

Substitute for White Lead.—Mr. Sace has called attention to the fact that tungstate of baryta forms an excellent white paint, which has as good a tone and depth as white lead, and has the advantage above this of not becoming blackened on exposure to the atmosphere. Zinc-white, which was tried as a substitute for white lead, has failed through wanting body.

Pigment Colours.—Among the very small number of books published on the subject of the manufacture of pigment colours the most recent is that edited by J. G. Gentile, published at Brunswick, by Vieweg and Son, under the title, "Lehrbuch der Farben Fabrication; &c.," 1860, or later. This is a most useful and complete treatise on this subject, and full of sound practical information.

Removing Carbonic Acid Gas from Wells.—A correspondent of the *Scientific American* gives an account of an ingeniously extemporised apparatus for removing carbonic acid from wells. It was simply an opened out and extended umbrella let down and rapidly hauled up a number of times in succession. The effect was to remove the gas in a few minutes from a well so foul as to instantly extinguish a candle previous to the use of the umbrella.

Coal Ashes.—A series of experiments conducted at the Museum of Natural History, Paris, during the past year by Professor Naudin, has resulted in the conclusion that coal ashes act neither as manure nor even as earth of the most infertile quality. It is certain, however, that upon a heavy clay they act as disintegrators, an effect which cannot very well be only mechanical, as a very small amount of coal ashes is sufficient to destroy the adhesiveness of a large amount of clay.—*Engineer.*

Products of an Alkali Work.—What is the yellow colouring matter in good strong sulphate of soda? What is the red colouring matter in red balls? What is the red colouring matter in red liquor? What is the red colouring matter in ordinary soda ash? In making a full analysis of soda ash ought the soda which is combined with the silica to be deducted from the total available soda? or, in other words, is the total available soda affected by the presence of silicate of soda?—X.

Dyes from Ochella Weed: Orchella.—"Chromo" is referred to "Ure's Dictionary of Arts, Manufactures, and Mines," 6th edition. (articles: Litmus, Lichen, Orchella Weeds, Orcin); also to "Watts's Dictionary of Chemistry," vol. iv. (articles: Orcein, Orchil, and others); and, lastly, for a very full account on this matter to "Theorie und Praxis der Gewerbe. Hand und Lehrbuch der Technologie," von Dr. J. R. Wagner, vol. iv., page 470 and following. All these works may be inspected at the library of the Commissioners of Patents.

Alloy for Silver Coinage.—The authorities of the Mint of France have been experimenting for replacing copper either partially or entirely as an alloy for the silver coinage of that country. The advantages are said to be that the metal (alloy) is more homogeneous, has at least as fine a white lustre, and possesses a clear ring and considerable elasticity. When toughened by continued or repeated rolling it annealed by simple heating, it is less liable to be blackened by sulphuretted hydrogen. A mixture containing 835 parts of silver, 93 of copper and 72 of zinc is recommended.—*Engineer.*

Lute for Corks.—Professor Hirzel, of Leipzig, recommends as a lute for covering the corks of vessels containing volatile substances (as for instance, benzin, light petroleum oil, and essential oils), a mixture made up of finely ground litharge and concentrated glycerine; this is made into a paste, and the corks or bungs are covered with it; this mixture hardens very rapidly, is insoluble in, and not at all acted upon by, the said liquids, and is inexpensive, inasmuch as even coarse glycerine, provided it is concentrated, answers the purpose.—*Dingl. Polyt. Journal.*

Chemical Nomenclature.—It strikes me that the following rule would be desirable in chemical nomenclature, at least as to organic compounds:—That "oxide of" (or chloride, &c.) should always be used where oxygen is added to the body, and "oxide" (&c.) after the name when a substitution takes place only, thus:—The true constitution would be expressed by the name (say of CH_3I), whether called "iodide of methyl" or "methane iodide"; but it should never be called "methyl iodide," to avoid confusion. So far as supposed radicals do not exist, unless in composition, attention to this rule would do away with an unnecessary assumption, and make the names more expressive of actual knowledge.—H. H.

Glycerine: its Uses and Abuses.—Tubs and pails saturated with glycerine will not shrink and dry up, the hoops will not fall off, and there will be no necessity for keeping these articles soaked. Butter-tubs keep fresh and sweet, and can be used a second time. Leather treated with it also remains moist, and is not liable to crack and break. It is used for the extraction of perfume from rose leaves and other scented materials; employed to preserve animal substances from decay, and therefore also to prevent many articles of food from undergoing decomposition; mixed with its own bulk of water it is used in gas-meters, owing to its requiring intense cold to freeze; the works of delicate chronometers, clocks, and watches are lubricated with it. It is largely used in pharmacy to keep moist and preserve extracts, pills, and other preparations; it is used in dyeing some of our beautiful organic colours; in chemistry it is applied to prevent the precipitation of the heavy metals by the alkalies, and is thus a reagent in analysis; it is used in brewing beer for making an extract of malt, as also in the manufacture of liqueurs (cordials); it is applied to the preservation, and no doubt to more than that, viz., the making of wines and champagne. Since glycerine can be fermented into alcohol with chalk and cheese, it may in future become a source of alcohol and acetic acid. Lastly, glycerine is the source of nitroglycerine, a most dangerously explosive substance, and of dynamite, which is simply nitroglycerine mixed with sand, and is much less dangerous than nitroglycerine, and nearly as destructive in its effects, as it contains 76 per cent of nitroglycerine.—*Abbreviated from the Scientific American.*

Swiss Concentrated Milk.—Results of analyses of concentrated milk, so-called extract of milk, prepared at Cham, near Zug, Switzerland. According to Dr. Bolley, 100 parts of the concentrated substance contain:—

Butter (fatty matter)	8.67
Caseine and lacto-proteine	13.67
Sugar of milk	10.82
Cane sugar (added previous to beginning the operation of concentration)	40.48
Mineral matter	2.23
Water	24.13

100.00

If we deduct the quantity of water and that of the cane sugar, there remains 35.39 per cent for the constituents of really dry milk. Since the dry matter of good cow's milk contains, according to an average of four analyses made at Cham by Dr. Bolley,

Butter (fatty matter)	3.95
Proteine substances	4.30
Sugar of milk	4.60
Mineral matter	0.72

it follows that 261 grammes of this milk contain as much dry solid matter as 100 grammes of the concentrated milk.—*Abstracted from Gewerbeblatt, &c., für Bayern.*

MEETINGS FOR THE WEEK.

- MONDAY, March 8th.**—Royal Geographical, 8½.
— Medical, 5. Anniversary Oration.
— London Institution, 6.
- TUESDAY, 9th.**—Royal Institution, 3. Rev. F. W. Farrar, "On Comparative Philology."
— Photographic, 8.
- WEDNESDAY, 10th.**—Society of Arts, 8.
— Geological, 8.
— Microscopical, 8.
- THURSDAY, 11th.**—Royal Institution, 3. Dr. H. Power, "On the Eye."
— Royal, 8½.
— Zoological, 8½.
— Royal Society Club, 6.
- FRIDAY, 12th.**—Royal Institution, 8. Professor Abel, "On Naval and Military Applications of Electricity."
— Astronomical, 8.
- SATURDAY, 13th.**—Royal Institution, 3. Dr. Odling, "On Hydrogen and its Analogues."

TO CORRESPONDENTS.

S. C. C.—We will make enquiries.

Soap-Tablet Stamping Machine.—A Subscriber who enquired for the above is informed that Messrs. W. Neill and Son, Engineers, Bold, St. Helen's Junction, manufacture a patent steam-power soap tablet stamping machine.

Refiner.—It has already been recorded that the heat of steam will ignite some readily combustible substances, especially after they have become very dry. This is so well known in sugar works that steam pipes, whenever they come near wood work, are always enveloped with sheet lead, felt, and a wooden case containing ashes, peat-ash in preference. Serious fires have been occasioned in oil and paper mills by steam heat.

Communications have been received from Professor Gustavus Hinrichs, Iowa (with enclosures); the Quekett Microscopical Society; Professor Brazier; G. Blogg; J. Berger Spence; Dr. R. Angus Smith, F.R.S.; J. H. Pepper; C. Heisch; R. Murray; Rees and Co.; G. H. Ogston; W. Mackenzie; W. M. Williams; F. C. Calvert and Co.; T. Hill; W. H. Harris (with enclosure); J. Muspratt and Sons; Dr. Andrews (with enclosure); Muspratt Brothers and Huntley; G. F. Glover (with enclosure), and Dr. Röhrig.

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THE CHEMICAL NEWS.

VOL. XIX. No. 484.

A NEW ELEMENT ACCOMPANYING ZIRCONIUM,

DISCOVERED BY MEANS OF
SPECTRUM ANALYSIS.

At the *soirée* of the Royal Society, on Saturday last, March 6th, Mr. H. C. Sorby, F.R.S., exhibited for the first time some phenomena in his spectrum microscope, which have led him to the conclusion that they are due to the presence of a new element, for which he has proposed the name of jargonium. The following is the account which Mr. Sorby then gave of this discovery:—

"Jargonia is an earth closely allied to zirconia, existing in small quantity in zircons from various localities, but constituting the chief ingredient of some of the jargons from Ceylon. It is, however, distinguished from zirconia and all other known elementary substances by the following very remarkable properties. The natural silicate is almost, if not quite colourless, and yet it gives a spectrum which shows above a dozen narrow black lines, much more distinct than even those characteristic of salts of didymium. When melted with borax it gives a glassy bead, clear and colourless both hot and cold, and no trace of absorption bands can be seen in the spectrum; but if the borax bead be saturated at a high temperature, and flamed, so that it may be filled with crystals of borate of jargonia, the spectrum shows four distinct absorption bands, unlike those due to any other known substance."

It appears however, by the following communication from Professor A. H. Church, M.A., that a similar, if not identically the same, discovery was published nearly three years ago. Professor Church writes as follows:—

"Royal Agricultural College,
March 6, 1869.

"I heard, when in London this week, that Mr. Sorby had discovered a set of black absorption bands in certain zircons, and had attributed their occurrence to the presence in the stones examined of a new element accompanying the zirconium. May I be permitted to refer your readers to the woodcut of these bands, which I published three years ago in the *Intellectual Observer* for May, 1866? The sketch was rough, and the cut badly executed, but it shows, though without the delicate shading of the original bands, the effect on solar light of its passage through a considerable thickness of a particular Ceylon zircon, or jargoon, in my possession. Not only did I describe the bands, but I noticed their occurrence in the spectra of some stones from particular localities (Ceylon), and their absence from stones from other localities (Espailly). I also added my views as to the cause of these bands—the presence of an element in some specimens, not found in others. I quote one or two sentences from the note referred to above:—'I am induced to hazard the conjecture that it may be, after all, Svanberg's *norium*, which determines the difference.' 'The absorption bands of zircon resemble those of didymium discovered by Gladstone, in their sharpness, and in their being produced by the passage of light through a colourless medium.'

"Since 1866, I have worked at intervals on the subject of the supposed *norium*. The rarity and costliness of the best and purest materials for the research—viz., transparent and flawless, and nearly colourless specimens—have seriously retarded the progress of my research. I have nothing ready for publication, but simply note the following points, which I have established with more or less certainty since the first conjecture which I made of an

element different from zirconium in the 'black-banded' jargoons:—

"1. That zirconium is accompanied by at least one other metal (probably by two), in some of the zircons from Indian, American, and Norwegian localities.

"2. That the seven black absorption bands discovered in 1866 are characteristic of this new element, in some of its combinations at least, although I have not traced them definitely in any solution as yet.

"3. That the atomic weight of one of the new accompanying elements is different from that of zirconium.

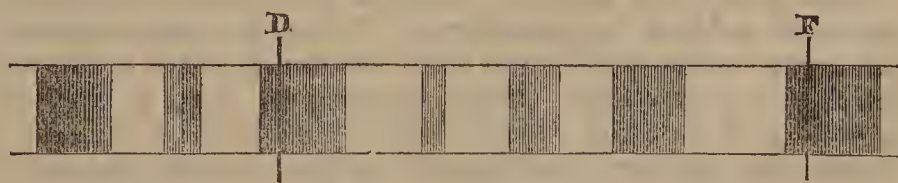
"4. That the density of those zircons which show the black bands most intensely in the smallest thickness, is lower than that of those zircons which show no bands or only very faint bands. (In 1866, I showed that neither the direction in which the light was transmitted through the crystal, nor the action of an intense ignition, had any apparent influence on the particular absorptive power of zircons for light now under discussion). Of course the comparison must be made with specimens in their native state and without flaws, or with specimens which have been similarly ignited, by which process the density is increased.

"5. The characteristic salts obtained from the black-band zircons may prove to have been included under those of *norium* by Svanberg. But, as that term does not exclude some bodies which are certainly different from those which seem to belong only to the black-band zircons, a new name may have to be coined. *Nigrium* suggests itself as at once appropriate and consistent with the received system of nomenclature.

"I may add that the black bands were shown or described at the time of their discovery to many of my friends, among whom I may name Dr. Gladstone, Mr. Slack, and Mr. John Browning.

"Some of the zircons employed in my experiments are described in the *Chemical Society's Journal* for 1864 (November and December). The best was of a very pale greenish hue and without a flaw. It weighed 1.1665 grammes, and its density before ignition was 4.579, after 4.625. A rather smaller Espailly specimen was orange-red before ignition, and had a density of 4.863. After ignition it became colourless, but its density remained the same. In neither state did it exhibit any black bands, nor have I obtained from several ounces of the zircon from this locality any other salts than those of zirconia."

Professor Church has forwarded the original drawing of the bands, torn out of his note-book. From this the following woodcut has been engraved.



It appears only fair both to Professor Church and Mr. Sorby, that the original article in the *Intellectual Observer* for May, 1866, should be given together with the above more recent notes. We therefore reprint it as follows:—

"MICRO-SPECTROSCOPE INVESTIGATIONS.

"Letter from Professor Church.

"The Editor has received the following interesting letter from Professor Church:—

"Have you tried the experiment with chloride of cobalt, which I mentioned to you? If you take the saturated cold solution of this salt it will give the spectrum roughly sketched in Fig. 1,* a thinner film of the same solution, heated (on a glass slide with thin cover) over the candle or lamp gives the spectrum drawn in Fig. 2.† You will

* "The figure alluded to shows the red darkened, the orange light, and a broad dark band commencing to the right of the yellow and extending beyond the line F; the remainder of the spectrum is cloudy."

† "Fig. 2 shows the narrow black bands in the red, modified tints replacing the broad dark band of Fig. 1, the blue coming out clear. The experiment is a very beautiful one."

notice two black bands, I had almost said lines, in the red. As might be predicted from the change of colour on heating, the solution is afterwards much more transparent to rays beyond D. The chlorides of copper and nickel also give very interesting results.

"But I think you will be most pleased with the experiment I have now to relate. I have worked lately on the spectra of pleochroic minerals and salts. Among the minerals recently examined were several fine specimens of the true zircon or jargon, a silicate of zirconia. These gave a beautiful and most characteristic system of seven dark bands quite different from those belonging to any other substance yet examined. They are roughly sketched in the following figure.* Zircons as colourless as common glass show these bands as well, perhaps better, than those possessed of colour. They are to be observed with zircons which have been ignited, as well as with those still in their natural condition. But some zircons show the phenomenon better than others, this difference not being due apparently to the colour of the stone or the thickness through which the light traverses. I am not quite sure, but I incline to think that those zircons which have come from some localities show the bands better than those from others. Several Espailly specimens scarcely exhibit anything of this kind; all those from Ceylon and Norway show the bands well. From this observation I am induced to hazard the conjecture that it may be, after all, the presence of Svanberg's *norium* which determines the difference. You are aware that the orange jacinth, a variety of zircon, is very precious, and that the essonite, or cinnamon-garnet, is constantly sold for it. Curiously enough, the cinnamon-garnet, or essonite (a lime-garnet), has no conspicuous dark absorption bands at all, and so the spectroscopic may be brought to bear upon the discrimination of these two stones. We have thus a much more ready process than that of taking the density of the specimens. The lime-garnet is of comparatively small value. The iron-garnet of different shades (carbuncle, almandine, &c.) gives a beautiful and very characteristic spectrum with several intensely deep absorption bands.

"I write these particulars of my experiments at once, for I thought you might like to make a little paragraph about them for the readers of the *Intellectual Observer*.

"I ought to add that the absorption bands of zircon resemble those of didymium, discovered by Gladstone, in their sharpness and in their being produced by the passage of light through a colourless medium. Silica, the other constituent of zircon, gives no bands."

The first who appears to have published researches on this subject is Svanberg. From his experiments he came to the conclusion that zirconia was not a simple earth, but a mixture of three, or perhaps even a greater number, of metallic oxides; and that these oxides are present in different proportions in the zircons obtained from different localities (*e.g.*, Siberia, Norway, and Ceylon), and in the hyacinth from Espailly in France. The atomic weight of these earths (supposing them to be sesquioxides) varies between 75 and 105.6, the mean of which, 91.2, is the atomic weight assigned by Berzelius to zirconia regarded as a simple earth. Svanberg could not succeed in completely separating these earths; but he found—1st. That the oxalate of one of them is less soluble in acids than the oxalates of the rest. 2nd. That the chloride of the radical of one of the earths is less easily soluble in hydrochloric acid than the corresponding compounds of the other radicals. 3rd. That the sulphate of one of them, when mixed with a large quantity of free sulphuric acid, crystallises much more easily than the sulphates of the rest, and likewise in a peculiar form. To the earth thus distinguished from the others with which it is associated, Svanberg gave the name of *norium*. This earth is likewise found in zircons from the Ilmenge-

berg. In the eudialyte from Greenland, Svanberg thought he had discovered (besides cerium, lanthanum, and didymium) two other earths, the first of which closely resembles yttria; the second has a yellow colour. According to Watts's "Dictionary," article "Norium," a subsequent experimenter, Berlin, throws doubts upon the composite nature of the earth commonly called zirconia. Now that attention is again directed to this subject, it is to be hoped that these doubtful points will be cleared up. There seems no lack of new elements waiting to be discovered, and further researches may show that Svanberg's *norium*, Church's *nigria*, and Sorby's *jargon*, are each separate entities.

Since the above was in type, we have received the following communication from Mr. Sorby:—

"36, Oxford Terrace, London, W.
"March 8, 1869.

"I send you an account of some of the objects I exhibited at the *soirée* of the Royal Society on Saturday, March 6th, illustrating the substance which gives such a remarkable spectrum.

"The specimen I showed was part of a jargon belonging to my friend, Mr. William Bragge, of Sheffield, who most kindly and liberally gave it to me for study. I soon found that the spectrum was not due to zirconia, since the zircons from some localities give no bands whatever: those from other localities show traces of the bands, as if they contained a small variable amount of the substance in question, mixed with zirconia, in the same manner that many are variously coloured with small quantities of the oxides of iron. If the borax blowpipe bead of this substance had given absorption bands, in the same manner as the oxides of didymium, erbium, cobalt, and uranium, there would have been no difficulty in proving whether or no it was a new elementary body; but when melted with borax it gave a clear, colourless bead, when both hot and cold, without any trace of absorption bands. Very many known oxides give such beads, and the question was whether any of these would give the remarkable absorption bands when they were in a crystalline state.

"There was no difficulty in proving that the crystalline silicates of a number of known earths and metallic oxides do not give any bands, but still a number of elementary substances could not be procured in combination with silica, or not in crystals sufficiently transparent to enable me to ascertain the fact for certain, though I prepared a large series of sections for this especial purpose. It was therefore open to doubt whether the substance which gave the bands was a new one or not, though I proved by my new blowpipe method that it was very closely allied to zirconia.

"At length it occurred to me that perhaps the production of the absorption bands depended on the substance being in a *crystalline* state, and I therefore saturated a borax blowpipe bead with it, and by flaming caused it to become full of minute crystals of the borate, so as to be white and almost opaque. By using a strong illumination, I succeeded in causing light to pass through the bead, and found that the spectrum then showed four absorption bands, very well marked, considering the nature of the case. None of these bands corresponded exactly with those of the silicate, and when microcosmic salt was added, so as to give rise to crystals of the phosphate, a spectrum was obtained with bands differing from both the others. The fact of the clear borax bead showing no bands until it is filled with crystals is, in my opinion, the most important yet discovered in connection with the subject, for it enables us to prove that the substance which gives the bands is no known earth or metallic oxide. Since it, therefore, appeared to be a new substance, and was found in certain specimens of the *jargon*, I thought no better name could be adopted than that of *jargon*.

"This was the state of my knowledge of the subject when I came to London a few weeks ago, bringing with me the printed description of most of these facts, to give away at the *soirée* of the Royal Society. My attention

* The diagram referred to is substantially the same as the copy from Professor Church's drawing printed on the previous page.

was subsequently called to Professor Church's letter in the *Intellectual Observer* for 1866, p. 291, which I had not previously heard of, since that work is almost unknown in the northern provinces. Judging from his description and figure, there can be no doubt that he had observed the spectrum of the same substance, only comparatively in a very imperfect manner, as will be seen by comparing his figure with that copied from my own drawing, shown at the Royal Society. He speaks of 'seven dark bands,' whereas my specimen shows double that number. He also says that 'all those from Ceylon and Norway show the bands well.' Now after having examined several hundred jargons from Ceylon, I must say that, in comparison with my own specimen, scarcely any show the bands *well*. There is not one single specimen in the British Museum that shows them even moderately well. One in the Museum of Practical Geology shows them in a very satisfactory manner, and I have seen two or three others that show them, though not anything like so well as my own, the exact locality of which must be considered to be still unknown for certain. Those from Norway show the bands in the same comparatively imperfect manner as the usual specimens from Ceylon, and, even assuming that my specimen contains but little zirconia, we must conclude that the zircons from both those localities contain only a small amount of the substance for which I have proposed the name *jargon*. If any one had only seen the usual kind of specimens from Ceylon or Norway, I can easily believe that he might have been led to conclude, with Professor Church, that the production of the bands might depend on the presence of Svanberg's *noria*. However, since the zircons from Norway (Frederikswarn), which, according to Svanberg, are so rich in his *noria* that it materially modifies the chemical equivalent of the earth and the specific gravity of the mineral, are, according to my own spectroscopic observations, so very poor in my *jargon* that they give only a very faint trace of the bands, I cannot admit that they are the same substance. My friend, Mr. David Forbes, has most kindly allowed me to examine the zircons from many localities in Norway, collected by himself; and given me a number to cut for examination; and I find that none contain more than a decided trace of my *jargon*.

"My own specimen of *jargon* is so rich in *jargon* that a piece one-tenth of an inch in thickness, and all but colourless, gives fourteen bands, as shown in the accompanying figure. Unlike most other absorption bands, thirteen

give two spectra side by side with the light polarised in opposite planes, as shown in the accompanying figure. The image in which the light is polarised in a plane parallel to the axis of the crystal (No. 1) shows a well marked double band in the red which is absent from the other image (No. 2), whilst that shows a band in the yellow part of the green which is absent in the other. There is also a difference in the position of several of the bands, and a difference in the intensity of others, whereas that in the yellow is nearly the same in both. These are remarkable peculiarities, since in most dichroic substances there is merely a difference in the intensity of all the bands.

"On the whole, therefore, it seems to me that these very striking absorption *lines* are due to an elementary substance not hitherto recognised, which can crystallise in all proportions as a silicate along with zirconia, and whose action on the spectrum varies to an unusual extent, according as it is in a vitreous state or crystallised in combination with different acids."

NOTE ON ARISTOTLE AND THE DISCOVERY OF THE WEIGHT OF THE AIR.

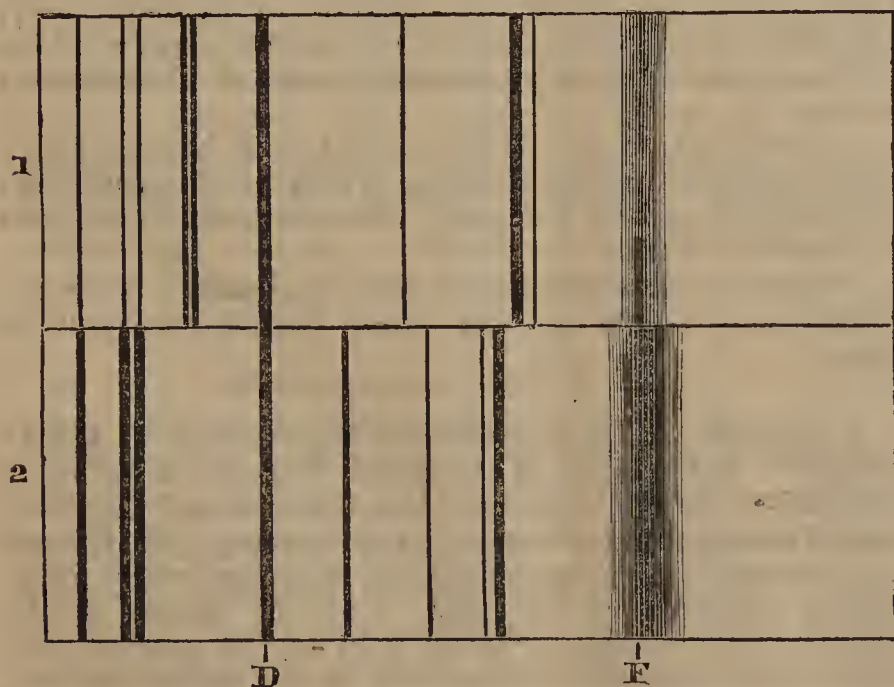
By G. F. RODWELL, F.C.S.

In the last number of this journal, M. l'Abbé Hamy has endeavoured to prove that, "before Galileo's experiment in 1643," the weight of air had been demonstrated by Aristotle. I alluded, in the *CHEMICAL NEWS* for Sept. 5, 1863,* to the passage in Aristotle's treatise, *Περὶ Οὐρανοῦ*, to which M. Hamy refers, and there stated that, as the experiment was made by weighing a bladder of air in air, the increase in weight before and after inflation undoubtedly arose from the aqueous vapour introduced by blowing into the bladder. I still incline to this opinion, and I have no hesitation in saying that there is no reliable evidence to make it even probable that Aristotle discovered the weight of air.

I am at a loss to imagine to what M. Hamy refers in the phrase, "before Galileo's experiment in 1643;" first, because Galileo died in 1642; and, secondly, because the experiment in which he demonstrated, by direct weighing, that the air has weight, was made some years before his death; or, again, as to whether he refers to the Torricellian experiment, which was made in 1643.

M. Hamy bases his assertion on the following passage from Aristotle:—"Suo enim in loco gravitatem habent omnia præter ignem. Signum cujus est utrem inflatum plus ponderis quam vacuum habere." It is much to be regretted that he does not give the original text; but supposing the Latin translation to be correct, let us examine the statements. I am quite willing to cede the word *bladder* and to substitute for it *leather bag* or *bottle*, which *utrem* rightly signifies, if, as I suppose, the word in the original is *αἰσκός*; but I would remind M. Hamy that Ptolemy the mathematician, who repeated the experiment, employed a bladder, as also did Simplicius, one of the most exact and careful of the many commentators of Aristotle. I have invariably seen the word rendered *bladder*, both by ancient and modern commentators. The verification of the statement that all bodies possess weight except fire, is furnished, says M. Hamy, by the experiment of Aristotle, "which consists in weighing, not an extensible bladder, but an almost inextensible leathern jar, successively full and empty of air." Now, by what possible means *utrem inflatum* can be rendered an *almost inextensible leathern jar* I am at a loss to conceive. It is *inflatum*, hence it can exist in a state of non-inflation or the one word would not be required to qualify the other; neither could a leather jar full of air (which, if *almost in-*

* "On the Supposed Nature of Air Prior to the Discovery of Oxygen."



of these are narrow and perfectly black lines, surpassing in this respect even those characteristic of salts of didymium. When the section is cut parallel to the axis of the crystal, though it is almost colourless with ordinary light, it is slightly dichroic, giving a reddish and greenish image. The reason of this is easily understood when the spectrum is examined with a double image prism, so as to

extensible, it must be at the commencement of the experiment) be called *vacuum*, and the same, with more air blown into it, *inflatum*. This is the very perversion of accurate diction, and of sound Latinity. *Inflatum* and *vacuum* are evidently here used antithetically,—an inflated condition opposed to a non-inflated condition; full opposed to empty. It seems to me that a tight seamless bladder capable of withstanding some internal pressure, and of being readily closed by tying, would suit M. Hamy's purpose much better than "an almost inextensible leathern jar," if he be bent upon showing that Aristotle discovered the weight of air. A leather bottle may contain a liquid, but what can be less adapted to contain a gas under pressure? M. Hamy would have it filled by a blowpipe; by which means he believes that Aristotle "confined in his leathern jar more air than it would normally contain," and then weighed it. Granting that the leather jar would stand pressure without leaking, let M. Hamy take the maximum pressure at which air can be forced from the lungs, and then calculate the quantity of air which could be thus condensed into a vessel, and the volume of that air requisite to give weight recognisable by a rough statera, and he will see the impracticability of the experiment.

According to M. Hamy, scientific men have not given the glory of the discovery to Aristotle "because in endeavouring themselves to test the truth of the assertion, many of them failed to detect any difference in weight between a bladder filled with air and one entirely empty." Let us hope many of them did fail; those who did not must have made an exceedingly gross error. Archimedes had proved that a body immersed in a liquid loses a portion of its weight equal to the weight of the liquid which it displaces, and this theorem applies here; since in the case of a bladder of air weighed in air, the air in the bladder loses *à priori* a weight equal to its own weight, it is clear that the bladder must weigh the same whether it be inflated or the reverse, and that the air weighs nothing in its own medium.

I can imagine how the demonstration of the weight of air was made by the philosopher who cared so little for the discovery of new truths. He is in the groves of the Lyceum in early morning, surrounded by pupils who are being instructed in acroamatics; he holds in his hand a leather bottle recently emptied of its Chian wine, or, perchance, the flaccid bladder of a Thracian bull, and, after a good deal of blowing, it is inflated and closed, Theophrastus, perhaps, acting as assistant (for he showed some taste for physics in after life). Then the inflated bladder is hung upon a clumsy statera, turning, perhaps, with the weight of half an Attic drachma, and the experiment is finished. But the students are not edified; they think it derogatory to study Nature, and one by one they wonder what their grandfather the Socratic would say to it all, or their father, who had sat at the feet of Plato.

We who deny that Aristotle discovered the weight of air are not "the philosopher's enemies," for this discovery would be almost a vanishing quantity when we consider how much he effected in other branches of knowledge; nor do we "strive to rob antiquity of its glories," for this discovery would add but little to an infinitely glorious past. Aristotle did not pretend to be an experimental philosopher; indeed, we question if he would thank M. Hamy for his disinterested attempt to make him one. Socrates and Seneca would have received such an imputation as an insult; the latter would have said (judging from some of his arguments in the "*De Vita Beata*")—"What matters it to me that the air has weight, I cannot alter it; let me rather strive to give weight to the actions of my life, and to leave a something which shall sink through all humanity." But, supposing that the discovery of the weight of the air had been made by Aristotle, we should not regard him as one whit the wiser man; it was not an age for the discovery of physical truths; the world was not ready for them; Pneumatics would not have become a science one year sooner, Otto Von Guericke would

not have teamed his sixteen horses to the great hemispheres of Magdeburg one day the earlier.

It is, I think, a most injurious practice to foist upon antiquity by means of vague and hypothetical premises discoveries which belong to a later age; and the reverse of this, which more frequently occurs, is equally pernicious. The transference of the merit of a discovery should never be attempted except upon the surest and most absolute grounds, and in the presence of indestructible facts. I say here, with M. de Strada—"L'activité humaine, si puissante, si immense, si agissante, qu'elle soit dans la connaissance, ne trouve j'amaïs en elle-même la certitude, mais la trouve toujours dans et par le fait."*

NEW APPLICATIONS OF THE MICROSCOPE TO BLOWPIPE CHEMISTRY.

By H. C. SORBY, F.R.S.

OF these there are two chief divisions. In one method the substance is fused with borax or microcosmic salt, so as to give a clear bead, and the spectrum is examined by means of the spectrum eye-piece. In the other method the saturated borax bead is kept hot over the lamp, so that crystals may be deposited in it. By using a microscope many elements may then be easily distinguished by the form of the crystals, which are often of extreme beauty. When, however, much mixed, or combined with silica or other acids, as in natural minerals, it is often requisite to add various reagents—as phosphate of soda, microcosmic salt, boric, tungstic, molybdic, and titanous acids. These give rise to characteristic crystalline deposits; and we may thus distinguish lime, magnesia, baryta, and strontia, even when combined with silica; and can detect magnesia when mixed with several times its weight of lime, in impure limestone, &c.

Examples of this method:—

1. *Sphene*, melted with borax, does not deposit crystals; but the addition of boric acid sets free the titanous acid, easily recognised by the form of the crystals. Diluting the bead with more borax, so as to retain the titanous acid in solution, phosphate of soda causes the deposit of crystals of phosphate of lime.

2. *Fergusonite*, from Greenland, shows the spectrum of didymium, and from Ytterby that of erbium. When fused with borax, it deposits crystals of columbic acid; and after diluting with borax to prevent this, the addition of phosphate of soda produces crystals of phosphate of yttria.

3. *Gadolinite* from Ytterby, melted with borax, gives a spectrum indicating the presence of didymium and erbium; and when kept hot, it deposits the characteristic crystals of borate of yttria.

Numerous illustrations of this application were exhibited at the *soirée* of the Royal Society on Saturday last.

Application of the Spectrum-Microscope to Mineralogy.—At the *soirée* of the Royal Society, on Saturday last, Mr. Sorby exhibited specimens illustrating the application of the spectrum-microscope to mineralogy. He showed that the following substances could be recognised in transparent minerals or blowpipe beads by means of the characteristic absorption bands seen in the spectra, even when they were much coloured by the oxides of iron, manganese, or nickel—viz., didymium, erbium (erbium of Bunsen; Delafontaine's terbium); uranium, cobalt, chromium, copper, manganese (when it occurs as permanganic acid), a new earth, for which the name *jargonite* is proposed, and another substance, perhaps also new, but not yet sufficiently studied.

* "Philosophie Méthodique."

ON THE
CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(ADAPTED TO A JUVENILE AUDITORY),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN,
(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, Esq., M.B., F.R.S.

(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE V.

GRAPHITE—DIAMOND—CARBONIC SULPHIDE.

Solution of charcoal in strongly-heated iron, to form easily fusible mass of cast-iron—Separation, from slowly-cooled cast-iron, of crystalline scales of graphite—Occurrence of graphite in nature as plumbago, or black-lead—Identity of graphite with charcoal, shown by formation of carbonic gas as the sole product of its burning—Its difficult combustibility in air, but ready combustibility in oxygen gas—Distinct chemical compounds of graphite—Production of graphite by strong ignition of the diamond—High relative weight and conductive resistance of diamond—Identity of diamond with graphite and charcoal, shown by formation of carbonic gas as the sole product of its burning—Combustion of diamond in oxygen gas—Liquefaction of carbonic gas by great pressure—Rapid vaporisation of liquefied carbonic gas, with great absorption of heat—Consequent freezing or solidification of residuary liquid—Slow vaporisation of solidified carbonic gas—Rapid vaporisation of solidified carbonic gas when wetted with ether—Great absorption of heat by the vaporisation, and consequent production of intense cold, sufficient to freeze mercury.

In this lecture I have to bring before you some very important points in reference to carbon or charcoal. You will remember that carbonic gas is oxidised charcoal,—a compound of charcoal or carbon with oxygen. I want now to call your attention to some other compounds of this charcoal or carbon, and one of the most important is that which it forms with iron. If we take a piece of fine iron, such as is used for wire, we shall find that it is either free from carbon, or contains a very minute proportion—not more than one-tenth per cent. How do we know this? We know it because, when wire is burned, it scarcely yields any carbonic gas as a product of its burning, and therefore we conclude that the iron is almost free from carbon; but if we take the same iron and heat it strongly in contact with charcoal, we find, afterwards, that it has undergone a considerable change. It alters very much in its character; it no longer possesses anything like the toughness it formerly had; it is either very soft or

very brittle, according to circumstances, but it has lost the toughness which characterised the piece of pure iron. It has, moreover, acquired this property, namely, that when it is burnt, either in air or in oxygen, it yields a very considerable amount of oxidised carbon, or oxide of carbon, or carbonic gas. It has taken up a considerable quantity of charcoal—a quantity which may occasionally amount to 5 or 6 per cent. It is often, however, 4 per cent of the iron, and we know that it has absorbed this carbon by the alteration in its properties, and more especially by the fact that, when burned, it yields burnt carbon as a product of combustion. Well, this substance which is so produced, differs very remarkably in another way from pure iron—it is readily fusible, whereas pure iron is very difficult indeed to melt, and requires special arrangements for its fusion. We find that this substance, which is obtained by causing wrought-iron to enter into combination with carbon or charcoal, is a tolerably fusible material, so that it may be used for taking the finest castings. It is no longer pure iron, but a chemical compound of iron and charcoal. Now, when this compound is allowed to melt and cool slowly, it presents a very curious appearance, being covered with a series of scales. Here is a sample lent me by Mr. Abel, and here is another still more remarkable in its character. When we pick out these scales and examine them, we find that they consist of nothing but carbon; and we ascertain this by the fact, that when burned, they only yield carbonic gas or burnt carbon; so that the carbon which at first went into the iron is separated from it in the form of these scales, and we find that these scales are identical with black-lead or plumbago; in other words, we have converted this ordinary carbon into a substance known as graphite, black-lead, or plumbago.

Now, for some of the properties of this black-lead. It is a crystalline substance, and consists of pure carbon; it yields nothing but carbonic gas upon being burned; it is met with in nature, being found in metalliferous rocks, in Cumberland more particularly, and it is also found in meteorites. Here is a very fine section of a meteorite; it is a piece of iron that has fallen to the surface of the earth—it has fallen at any rate from the skies, and how much further we will not speculate. When we cut a meteorite in halves and get a section of it, we find that a great part of it is composed of iron; but in addition to the iron, we can pick out pieces of this black-lead, or graphite, or plumbago, such as we can manufacture artificially, in the form of scales, from the compound of charcoal and iron. Here is a piece which has been extracted from a natural mineral. Now this graphite, when burned, yields carbonic gas,

* Reported verbatim, by permission of the Author, for this Journal.

which has the property of converting lime-water into chalk and water. If you look at my notes or syllabus of the lecture, you will find written, with regard to this graphite, "Its difficult combustibility in air, but ready combustibility in oxygen gas." Well, that is rather an understatement of the question; it is so little combustible that, for practical purposes, it may be considered incombustible. I have mentioned its "ready combustibility in oxygen," but even in oxygen graphite burns with very considerable difficulty, and some contrivances must be adopted to enable it to burn fairly. For this purpose I will take a specimen of this powdered plumbago, black-lead, or graphite, and introduce it into a tube, formed of a piece of platinum foil. I put a small quantity of the graphite into the tube, and now I will light it by means of a piece of ordinary charcoal or pastille. Having ignited the charcoal, I will allow a current of oxygen gas to pass on it, and when once the graphite takes fire, you will observe, I think, that it will burn with very considerable brilliancy. The graphite has now ignited, and you see the very brilliant manner in which it burns. It is, then, capable of being burned in this way in a current of oxygen, and, in burning, it produces nothing but this carbonic gas, or oxidised carbon as its product of combustion, proving that it consists of nothing else but, and is identical with, carbon. Now, this substance, graphite—this form of carbon—has been examined very carefully by Sir Benjamin Brodie, who has found that it has some very curious properties, and to some of these I will direct your attention. If we take charcoal, and act upon it by chlorate of potash and oil of vitriol, the effect is such that it is impossible by the eye to distinguish the product from ordinary graphite; but it differs from graphite in the effect of heat on it. You will see the black substance which we have at the bottom of the test tube covering it to the depth of half an inch or so; upon this I will now try the effect of heat. The action is already taking place, and you observe that the mass is beginning to grow. It is giving off steam, and now this substance, which has been partly acted upon by the acid, and become partly oxidised, has swollen up to such an extent as to occupy fully two-thirds of the tube, and I have no doubt that, by continuing the heat a little longer, I may be able to push the substance up to the very extremity of the tube. It is still moving upwards, and getting nearer and nearer to my fingers every instant. The tube is now very nearly full; in another moment I shall not be able to hold it,—it will become so hot; and now you see that this black-lead, which formerly occupied a very small part of the tube, has swollen up and filled it.

Well, what is the nature of this change?

It was only ordinary black-lead. We acted upon it by the mixture; I applied heat to it, and thereby converted it into the original black-lead with which we started. Now Sir Benjamin Brodie has submitted some of this graphite to the action of very strongly oxidising agents, and has so converted it into a yellowish crystalline substance, which he calls *graphic acid*. I heat some of this graphic acid, which has kindly been supplied for this occasion by Sir Benjamin Brodie, and you will see that its behaviour is still more curious than that of the graphite with which I operated a minute ago. I take even a smaller quantity of this graphic acid than we did of the graphite. I apply heat to the flask containing the substance; you see, from the sparks, the combustion that is taking place inside the flask, and you also see the large amount of soot that is being generated. [A pause]—The action is now over, and you will observe that our flask is completely full of soot. In this way, I have converted our graphite back into ordinary charcoal, of which I have here sufficient to fill the tube entirely.

I have told you one or two ways in which graphite may be made, and now I will show you another. You are all familiar with the diamond. Mr. Tennant has lent me a collection of diamonds which are in the tray before you. I am afraid they will not prove as interesting to the ladies as if they were mounted in a different fashion, but they are mounted in this way to display their various colours. Of course, the finest diamonds are colourless. You will see the beautiful manner in which these stones glisten now I illuminate them by the magnesium light; and if you take the trouble to examine them after the lecture, you will see that they are well worthy of examination, because they are not cut simply in the ordinary form, but so as to show that they present nearly all the colours which diamonds possess. Now, the diamond has this property—that it will stand a red heat. You may make it red hot, and it will be none the worse for it, but there is a degree of heat which it will not stand. The degree of heat, capable of being produced by the electric arc, alters the diamond; and into what does it alter it? Into a mass of graphite or plumbago. We come, then, to this conclusion,—that as diamond is the same thing as plumbago, and as plumbago in its composition is nothing more than ordinary charcoal, therefore diamond itself is only charcoal; and we can ascertain this fact in another way, for when a diamond is burnt in charcoal it yields this carbonic gas. I now want to show you the result of its combustion. Here we have a jar of oxygen gas, here we have a diamond, and here is an arrangement for making the diamond red-hot by means of a galvanic current. I introduce the diamond into our globe of oxy-

gen, and while there I will make it red-hot. When it has once become hot, it will burn in the globe for an instant or two. I am now making our diamond red-hot; it takes some little time to bring it to the proper heat: but as soon as this is attained, it will begin to burn. The burning of the diamond in oxygen is attended by the formation of carbonic gas, the presence of which is indicated by the ordinary lime-water test.

There is one further remark I wish to make to you relative to the diamond. It differs from plumbago in appearance, and also in specific gravity, for it is a very heavy substance. An ordinary piece of plumbago is about two and a quarter times as heavy as water. Charcoal is from one and a half to twice the weight of water, but the diamond is three and a half times as heavy, and hence is a very much heavier substance than ordinary charcoal, or even than plumbago; and so, again, with regard to electricity. There are some bodies through which the electric current will pass freely; through others it does *not* pass, as they are capable of resisting the current. Now, a diamond resists the current, whereas charcoal does not; thus a diamond differs from charcoal in this as well as in many other very important particulars.

I will now call your attention to a remaining property of carbonic gas, which is that, when it is compressed, it is capable of being actually brought into the liquid state. That iron vessel before you is at present filled with what was carbonic gas. It is so no longer; it is liquefied, and might be called *carbonic liquid*. It is like water in appearance, and consists of nothing but carbonic gas compressed into a liquid condition. This liquid is a very curious substance, and when, by removing the pressure, we allow it to escape into the gaseous state, it becomes intensely cold. Why it thus becomes cold I cannot stay to tell you, but when this reduction of temperature takes place, the substance is partly converted into the solid state. When converted into the gaseous state, or into carbonic gas, the liquid becomes so cold, and absorbs so much heat, that the remainder is converted, as I have said, into the solid state. I am now going to collect some of this solid substance in a box. I warn you that upon opening the cylinder there will be a little noise, but you must not be startled by it. Before putting the box upon the cylinder, we will allow some of the carbonic gas to escape, and you will see it solidifying in the air. [Some of the compressed gas was then allowed to rush out of the cylinder, and on doing so it formed a white snow-like shower of solid carbonic acid]. You see we thus get a large quantity of this carbonic snow.

I will now try to collect some of this solid

matter in a box. [Some of the compressed gas was allowed to escape into a brass box, and there became solidified]. Our box is now full of the solidified gas, which I will empty out. That you may see how cold it is, I will place a piece of ordinary wet flannel round the box. You see that when I do so, the flannel is at once frozen so firmly to the box, that I can support its weight by means of the strip of frozen flannel. I will now take a portion of this solid gas and put it into a retort, and then you will see its gradual conversion into the gaseous state, and I shall be able to collect some of the gas over water. After putting the substance into the retort, I close it with a stopper, and that which was carbonic solid is gradually, as you see, converted into carbonic gas, and that gas is being collected over water. I will now give you another illustration of the property of this substance. Although it is so very cold, yet when I place a piece of it upon my hand, I do not feel it to be so; I can keep it there for a considerable time. The solid itself does not touch my hand, for it is separated by some of the carbonic gas into which it is becoming resolved, and hence it does not seem very cold to me, although it very readily froze the piece of flannel. If I let some of this substance come into contact with water, you will see its curious action; I will allow a piece to float on water, and you see it is gradually and very slowly evaporating. It does not freeze the water, although it froze the flannel in an instant. Here is another illustration of this property. If I take a common soda-water bottle, and fill it with ordinary water, I convert this ordinary water into soda-water, by adding to it some of this solidified carbonic gas. I will take a few pieces and drop them into a bottle of water. I then cork the bottle and shake it up for a minute or two, and we shall find that the carbonic gas so produced, dissolves in the water, and converts what was a bottle of ordinary water into a bottle of soda-water. [After a short interval]—The solid carbonic gas which I put into the bottle of water has slowly dissolved, and I know that the experiment has succeeded, because it is as much as I can do to hold the cork in the bottle. You see, when I remove my hand, that the cork flies out, and that we have obtained a bottle of soda-water which effervesces in the usual manner.

I will give you another illustration of the freezing properties of this solid carbonic gas. I here take a stool, and upon it I pour a little water. I then place upon the wet stool a glass beaker, into which I put some of the solidified gas. The evaporation from the substance contained in the glass is so rapid, that in an instant or two we shall succeed, I have no doubt, in freezing the beaker to the wet stool. [The freezing took place almost instantaneously, and,

in order to demonstrate the firmness of the adhesion, the lecturer lifted the stool by means of the glass beaker which was frozen to it]. You see the vessel is frozen to the stool with very considerable force, and a good deal of strength would be required to detach it.

I will now endeavour to freeze a quantity of mercury with a further portion of this solidified matter. [Some mercury was frozen by being brought into contact with the solid carbonic acid]. I have now frozen our mercury sufficiently for you to see the character of this freezing action. I hold the mercury by a wire, and, in this way, I can lift it. I will suspend the mass of mercury in water, where it will melt, and when it melts, you will see it pouring down through tubes of ice. Now when you consider that the temperature required to freeze mercury is exceedingly low—forty degrees below the freezing point of water—you will be able to form an idea of the great degree of cold which we can attain by the use of this solidified gas.

We have sufficient material left for a final experiment. I will put some of the solidified gas into a red-hot crucible, add a little ether, and then some mercury, and even then the mercury will be frozen. [The experiment was performed with a successful result.] We have succeeded in actually freezing mercury in a red-hot vessel. Here we have brought the mercury to a solid mass. I will now put it into some water, and it at once begins to liquefy, and as it liquefies it freezes the water, and forms little hollow tubes of ice, through which it falls to the bottom.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 4, 1869.

Dr. WARREN DE LA RUE, F.R.S., President, in the Chair.

THE names of the following candidates for election were read:—

For the first time—Mr. W. H. Deering, Assistant Chemist in the War Department, 12, Surrey Square, Old Kent Road.

For the second time—Mr. T. Bolas, St. Mary's Hospital; Mr. W. F. Catcheside, 12, St. Paul's Road, Camden Town; Mr. F. Clowes, 15, Cornwall Place, Holloway, N.; Mr. C. Hunt, London Gas Company, Nine Elms.

For the third time—Mr. J. J. Day, 173, Gloucester Road, Regent's Park.

The last-named gentleman was then duly elected by ballot.

The PRESIDENT regretted to have to announce that he had received a note from Dr. Frankland stating his utter inability to accept the office of president for the ensuing year. A new list would therefore be issued in a few days, in which the name of another gentleman would be substituted for that of Dr. Frankland.

Mr. TOMLINSON then read his promised lecture, "*On Catharism, or the Influence of Chemically Clean Surfaces.*" He commenced by referring to the previous researches of Oersted, Schönbein, and Liebig. In Oersted's researches, published in 1806, dilute acids were cautiously added, drop by drop, to solutions of alkaline carbonates; and similar experiments were made with other liquids. Almost no action took place at first; but on the introduction of any solid body, such as a platinum wire, a glass rod, or the finger, brisk effervescence occurs. He inferred that gas, in solution, is never given off except in contact with a solid, and he adduced the influence of solids in promoting crystallisation in support of his view. Analogous experiments were made by Schönbein in 1837, who suggested that the solids acted by carrying down air. Further illustrations were supplied by Liebig in 1839, who concurred in attributing the effects to the influence of the air introduced.

Mr. Tomlinson, after quoting these experiments, and giving some further instances of a similar kind, remarked that whether gas, vapour, or salt escaped from solution, most writers asserted the influence of some mysterious function in the air, while Gay Lussac imagined that the boiling point varied with the nature and condition of the vessel. In this he was followed by Löwel, who devoted eight or nine years to the investigation of supersaturated solutions. Mr. Tomlinson then explained the sense in which he applied the new term catharism (from *καθαρος*, pure or clean), distinguishing between "clean" in its ordinary and in its chemical sense. The finger could not be made chemically clean by any process, whereas a glass rod, cleansed with strong acids or alkalies, and well washed, was chemically clean, and no longer possessed the power of liberating either salt or vapour from liquids. The action of solid bodies in determining these changes he ascribes to the greasy film which, after exposure to the air, they are sure to acquire. For this film, the adhesion of the solid or vapour is greater than it is for the glass, and hence the effect of the solid. To such chemical uncleanness all phenomena of this kind should, he thinks, be ascribed, and he defines a nucleus as a body which "has a stronger adhesion for the gas, or the salt, or the vapour of a solution, than for the liquid which holds it in solution." He repudiates the notion that temperature has anything to do with the phenomena of supersaturation, and describes experiments in which supersaturated solutions of various salts were kept for hours in catharised vessels at a temperature of 10° F., without crystallisation taking place. This was even observed with alum, which does not usually exhibit this peculiarity. The views of Löwel on crystallisation, and the phenomena of *soubresaut*, or bumping, during ebullition, were next discussed, and a variety of interesting facts were described, for the particulars of which we must refer to the original paper. The action of porous bodies in assisting distillation was explained by their absorption of the vapour of the boiling liquids, which was subsequently given out in never ceasing jets; and a number of obscure phenomena in chemistry—such as the passive condition of iron, and the slight action of sulphuric acid on pure and amalgamated zinc—were explained by the doctrine of catharism, for which the lecturer claimed the properties of a principle of nature—viz., generality and breadth of application—a principle which was as yet new to science.

The PRESIDENT, in offering the thanks of the meeting to Mr. Tomlinson for his interesting paper, remarked that the main point appeared to be to determine the bodies which had the power of liberating gases from solution. The phenomena were very complex, and he did not quite see that we had arrived at an explanation of them.

Dr. W. A. MILLER did not suppose that Mr. Tomlinson's experiments had brought us nearer to knowing the cause of the difference in adhesion of different substances, but he thought that some advance was made by Mr. Tomlinson in tracing a number of widely different phenomena to one very generally operating cause.

Professor WILLIAMSON referred to the experiments which Mr. Grove described to the Society some years ago, in which he failed to get any ebullition in the absence of gas, and remarked that we could hardly doubt that the presence of air was favourable to the process. He objected to the use of the term catharism, as tending to draw the attention off from the particulars of the evidence before the facts were sufficiently well known and classified. In reference to the use of the term, it was well known that nothing produced the crystallisation of supersaturated sulphate of soda so easily as a crystal of the same salt, and yet it could not be said that such a crystal was not chemically clean.

Dr. GLADSTONE fully agreed that Mr. Tomlinson had cleared away the false explanations that had been given as to the influence of rough surfaces in promoting crystallisation on the evolution of gas, but doubted whether Mr. Tomlinson's theory was capable of explaining the phenomena in question. The nucleus, as Mr. Tomlinson defined it, had nothing to do with cleanliness or uncleanness. Paraffin might be made perfectly clean, and yet it would certainly produce the effect of recovering a salt from solution. It would be better, he thought, to get rid altogether of the words clean and unclean in this matter.

Mr. VERNON HARCOURT thought it an objection to the principle of the paper that it was purely a negative principle. It would be more satisfactory if we could, as the President had suggested, learn of what kind the substances were which produced these results. In some recent experiments on the rate of decomposition of peroxide of hydrogen the speaker had found that when the dilute solution was heated in perfectly clean glass bulbs the evolution of oxygen was greatest; that it was less when the bulbs were not clean, and that it was reduced to a minimum by varnishing the bulbs inside. This seemed to be directly opposed to Mr. Tomlinson's theory.

Dr. ODLING believed that Mr. Tomlinson would be best rewarded for the interesting information which he had given by hearing the utmost possible number of objections to his views. He doubted Mr. Tomlinson's explanation of the action of nuclei in apparently homogeneous glass, and dissented from his conclusions on several other points. He remarked incidentally that it was scarcely fair to refer constantly to the very old experiments of Saussure's on the absorption of gases by charcoal, to the exclusion of the recent, and probably more accurate, experiments of Mr. Hunter. Mr. Tomlinson had found a new name for cleanliness, but had been more respectful to dirtiness. He said that catharism was a principle of nature, but it was open to question whether dirtiness had not a fair claim to be reckoned a principle of nature also.

Professor FOSTER did not think that Mr. Tomlinson had disproved De Luc's theory that air, or gas of some kind, was necessary for ebullition. The effect of cleaning a glass rod, for example, was, he thought, simply to cause the liquid to wet it more thoroughly, and so to exclude the film of air. He quoted a number of facts which seemed to support De Luc's theory.

Mr. HEISCH remarked that Mr. Tomlinson's theory could not apply to the passive condition of iron, because the immersion of only half an inch of an iron wire in strong nitric acid would render the whole wire, even 50 or 60 feet of it, passive to that acid, though not to another sample of it. The fact of the wire being cleaned by the nitric acid would not explain these facts.

Dr. CRACE CALVERT pointed out that acetic and carbolic acids possessed the same properties as sulphate of soda in a more remarkable degree. They might be shaken or stirred to any extent, with or without dirt, with any stirrers, clean or dirty, and in vessels that were far from being chemically clean, and they would remain perfectly liquid, whereas the introduction of a crystal the size of a pin's head would render the whole mass solid in a few minutes.

Mr. TOMLINSON, in reply, expressed his thanks to the president and the other fellows present for their full

discussion and free criticism of his paper. In regard to the action of charcoal, he could not imagine, that when a piece of charcoal was heated to redness in sand and then immersed in mercury or in a boiling liquid, there was much air remaining in it. It could only act in virtue of its capillarity. After answering some other objections which had been urged, he remarked that he did not pretend to explain adhesion, but that it could not be doubted that there were differences in adhesion. He commented on Mr. Grove's experiment, and expressed his desire to see it repeated under different conditions. He denied the peculiar power of producing crystallisation usually ascribed to a crystal of the same compound. He had suspended clean crystals of sulphate of soda in the neck of the flask during the boiling of the solution, and found that when he pushed the crystals down into the solution, after twelve or fourteen hours, no crystallisation was produced.

Most of the other objections alleged were then discussed in detail, but the time prevented the consideration of all of them.

The society adjourned until Thursday, March 18th.

PHARMACEUTICAL SOCIETY.

Wednesday, March 3, 1869.

H. SUGDEN EVANS, Esq., Vice-President, in the Chair.

THE minutes of the previous meeting were read and confirmed.

After some remarks from Professor Bentley on some specimens of dried herbs, and from Mr. Hanbury on a specimen of blackish green insect wax forwarded from India by Dr. Baillie,

Mr. C. H. WOOD proceeded to read a paper "*On Sulphurous Acid*." He found no difficulty in obtaining a 1.48 per cent solution in three hours, by passing a stream of the gas through water, and keeping the receiver as cold as possible; to obviate the inconvenience caused by a considerable amount of the gas passing off towards the end of the process, the operation can be carried on in the open air, but more charcoal and vitriol is required than ordered in the Pharmacopœia. The author preferred using a quicksilver bottle with a bent tube, to a glass retort. With regard to the test for strength, he had found that, by mixing 34.7 grains, by weight, with 1 pint instead of 1 ounce of water, as ordered in the Pharmacopœia, the proper proportion and accurate numbers were obtained.

Professor ATTFIELD confirmed Mr. Wood's statement regarding the test; he had thought the ounce was a misprint for a pint.

Professor REDWOOD could not plead that the ounce was a misprint for the pint, but he was of opinion that acid of the strength ordered in the Pharmacopœia was not so easily obtained or kept in a state of uniformity as one of much less strength. The committee of the Medical Council had sanctioned that the strength should be modified in the next edition of the Pharmacopœia, which, however, would not be published for some years; but as long as the process remained in the Pharmacopœia, it must be adhered to.

Mr. W. A. TILDEN, B.Sc., F.C.S., then read a paper "*On Diluted Nitro-Hydrochloric Acid*." The author had endeavoured to find out if there was any advantage or difference in the process of mixing the acids and allowing them to stand before diluting, or diluting the acids at the time of mixture. Six drams of the acid, mixed and diluted at once with water, required for neutralisation 904 grain measures of the volumetric solution of soda, while 6 drams of the officinal acid required 870 grain measures. The difference in the saturating power of the pharmacopœia acid was accounted for by the loss of 1-50th of its volume. Nitric and hydrochloric acid being mixed

with the water at the time, in such proportions as ordered, will give a liquid that will answer the tests and be the B. P. acid, although not made according to its directions.

Professor REDWOOD said the reason for adopting the B. P. process was to get an acid at once that would contain free chlorine in solution. The process caused discussion in the Pharmacopœia committee—there was a contest as to how it was to be described; if the acids were to be mixed in a bottle stoppered or open, perfectly or partially stoppered. By mixing the acid in a capacious stoppered bottle, saving the gas, adding the water gradually, and shaking, an acid is obtained with the contemplated proportion of chlorine.

CORRESPONDENCE.

NOTES ON LECTURE EXPERIMENTS.

To the Editor of the Chemical News.

SIR,—Some time ago I called attention to the subject of lecture experiments, and stated that it would be of great service to those engaged in the work of science teaching if occasionally hints were thrown out in the columns of your journal for the proper performance of such experiments as one meets with in ordinary manuals, but which, in the majority of cases, are most incompletely put before the reader, as those who attempt to repeat the experiments soon discover. It is true the experimenter may soon find out the cause of failure and remove it, especially if he be one accustomed to lecture demonstration, but there is surely no necessity for hundreds of persons each to overcome the same difficulties, when a few lines in this column from any one of them would save trouble to the whole. Lecture experiments or more properly *demonstrations* are invaluable as a means of impressing facts upon the minds of students in science, and it appears to me that sufficient importance is not given to them in manuals. Besides this, as an additional and perhaps more weighty argument for a column specially devoted to lecture experiments, there are continually new modes of demonstration being devised, but for want of a recognised journal in which to record them they are lost, except to the few who may have been present when they were exhibited.

I would venture to ask you, sir, in the name of myself and several of my friends who are engaged in science teaching if you would allow a column occasionally in your journal for notes and queries respecting lecture experiments not doubting, from the reasons I have given above, that by so doing you would be conferring a favour on a large number of your readers.—I am, &c.,

C. J. WOODWARD.

Midland Institute.

SPURIOUS GUANO.

To the Editor of the Chemical News.

SIR,—In reply to the objections raised by your correspondents, Messrs. Rees, to my remarks on this subject, I beg to say that those remarks were based upon the analysis and account given of the manure by themselves; that in those remarks there was not anything either "unwarrantable" or "set against" the analysis and reports since published in your columns, which confirm, as might have been expected, the analysis by Mr. Ogston, and furnish the most complete justification I could wish for of my estimate as to the value of the manure.

The analysis and reports on this manure do not bear out the assertion that "it is undoubtedly the most valuable that has yet been offered to the farmer," or the statement that the chemists referred to give "the highest opinions" of the value of this manure, nor do they accord with the statement that, in reference to its composition, it is a cheap

manure, for none of the chemists named put an actual money value on the manure, but merely term it "a very valuable manure," which may fairly be said of it or of any other manure worth more than £5 per ton; and Dr. Voelcker's recommendation is judiciously qualified by the proviso "if it can be sold at a reasonable price."

The manure is said to consist of a "basis" of Peruvian Government guano, but, at any rate, it contains, "amongst other ingredients," superphosphate of lime, which is of lower value than that guano.*

As my friend, Mr. Ogston, has thought it necessary to say a few words in reply to me, the fitness of which, from his point of view, I can appreciate, and am quite willing to admit, it is with much regret that I see he has gone out of the way to charge me with having made a very unjustifiable attack upon his clients, and to misrepresent me as having stated there was "no Peruvian guano at all" in the manure. No such statement was made by me. Mr. Ogston is also in error in stating that Dr. Voelcker, Professor Anderson, Mr. Way, Mr. Sibson, and himself, differ from me on all points. This is not the case; for the analyses of those gentlemen are, in fact, the basis and justification of my opinion. Mr. Ogston has, of course, full right to hold or express a different opinion, but I venture to think he is not justified in presuming to assert that I cannot be familiar with the subject on which I wrote, and in doing this he has gone beyond his province. Mr. Ogston, I am sure, is sufficiently conversant with the value of manures that, if his client were a farmer, he would not assign to a manure having the composition represented by his analysis a value of £11 per ton; and I do not believe that in any case he would have certified such to be the case.—I am, &c.,

B. H. PAUL.

8, Gray's Inn Square,
March 6th, 1869.

CHEMISTRY OF SUGAR REFINING.

To the Editor of the Chemical News.

SIR,—In No. 472 of volume xviii. of your excellent publication is an able and exhaustive paper by Dr. Wallace, "On the Chemistry of Sugar Manufacture and Sugar Refining," wherein occurs a passage to which exception must be taken, as it is of a nature to create false impressions.

After speaking of the injurious action of weak acids, which invert cane sugar, and enable liquors to dissolve iron from animal charcoal and from iron tanks and cisterns, besides other impurities, Dr. Wallace adds, "In this way Mr. Beanes's process for treating animal charcoal with hydrochloric acid gas, although otherwise all that can be desired, has entirely failed, and has caused ruinous expense to some refiners who have used it."

While admitting the premises of Dr. Wallace, I fail to see how he arrives at his conclusion. Were it true that Mr. Beanes's process produces weak acids, the conclusion would be perfectly legitimate.

I feel authorised to speak on the subject of Mr. Beanes's process for purifying bone-black. I was one of the first in the United States who became acquainted with the process, and for the last two years I have had charge of it at the refinery of Messrs. Havemeyers and Elder, in Brooklyn, E.D., opposite New York. They refine 100 tons of sugar daily, and treat weekly 220,000 lbs. of bone-black by the process of Mr. Beanes. They have now three large apparatus for making the hydrochloric acid gas in constant operation, and are putting up more retorts.

In view of my experience, I deny that weak acids must necessarily be formed in the sugar solutions by the use of Mr. Beanes's process, except under the most careless

* Owing to the pressure on our space, we are obliged to omit from this letter a tabular comparison of the published analyses of the guano under discussion, with an analysis of Peruvian guano made in 1856 by Mr. Way.

and unskilful management. Only two circumstances can give rise to the formation of weak acids in connection with the process of Mr. Beanes. Either the bone-black is left acid and the liquor dissolves acid from the bone-black, or the water left in the bone-black weakens the liquor sufficiently to allow fermentation to take place readily.

At the refinery of Messrs. Havemeyers and Elder there is no trouble from either cause of acidity. The sugar solutions after filtration are neutral.

I am led to believe, from the passage of Dr. Wallace's discourse quoted above, that an account of the means we employ to avoid acidity in the bone-black would be of use to the refiners in England who purify their bone-black by Mr. Beanes' process. I may briefly state that acidity is prevented in the bone-black—

1. By using peroxide of manganese in the hydrochloric acid generator, to avoid the formation of sulphurous gas.

2. By saturating the bone black with hydrochloric acid gas only when it is dry and very hot, as it comes from the revivifying kilns.

3. By using the hydrochloric acid gas dry.

4. By allowing the saturated bone-black to stand in suitable receivers till the excess of gas, if any, is absorbed before washing.

5. By washing the bone-black thoroughly after saturation to remove the chloride of calcium and other soluble salts.

It may be well to state that the use of wet bone-black in the filters consequent on the employment of the process of Mr. Beanes, is not of itself a cause of acidity in a refinery. On the Continent of Europe, and I believe in England, the bone-black is often used wet in the filters without any harm resulting from this practice. Differences of results obtained from the use of wet black must be due to differences of management.

In the two largest refineries in the United States, that of Messrs. Havemeyers and Elder of New York, and the Franklin Sugar Refinery of Philadelphia, also at Las Canas, the Sugar Estate of Don Juan Poey, the scientific planter of the island of Cuba, the process of Mr. Beanes has been adopted, is working successfully, and the best results have been obtained.

Dr. Wallace renders a just tribute to the process of Mr. Beanes when he says that it is "otherwise all that would be desired." I am able to add that it is not necessarily a source of acidity in a refinery.

The apparatus in use at the above-mentioned establishments differs from the one previously in use in the manner of drying the hydrochloric acid gas, which is accomplished without the use of chloride of calcium.

Hoping that the above may prove useful to the sugar refiners of England,—I am, &c.,

P. CASAMAJOR.

98, Wall Street, New York,
February 22nd, 1869.

MISCELLANEOUS.

Solubility of Indigo.—M. Camille Kœchlin has discovered the curious fact of the solubility of indigo in alkaloid salts, and particularly in the acetates and chlorides of aniline, morphine, &c.

Fearful Explosion.—On Wednesday afternoon a terrible explosion occurred at the works of Messrs. Demuth and Co., the well-known carbolic acid manufacturers. A retort burst, and set fire to a number of barrels of naphtha. Two of the *employés* were burnt to death, and four others received very serious injuries.

Scientific Instruments.—We understand that Mr. Heisch has relinquished the proprietorship of the business at 69, Jermyn Street, carried on under the name of Murray and Heath. He is succeeded by Mr. Robert Murray, whose father established the business, and as he has for

many years acted as manager for Mr. Heisch, he will, we believe, fully maintain the just reputation this firm has acquired.

Remarkable Property of Teroxide of Thallium.—Chemical processes enable teroxide to be obtained with great facility as a dark brown powder, presenting a striking resemblance to peroxide of lead. All that is necessary for this is to digest by heat some newly precipitated chloride of thallium in a solution of hypochlorite of soda, containing an excess of alkali. If a mixture of this dry teroxide and flour of sulphur is submitted to a moderate friction it ignites with explosion. When, on the contrary, to the same teroxide is added the eighth of its weight of the product vulgarly called golden sulphur, it is observed that the ignition requires less rubbing, and takes place without explosion. We may then hope, sooner or later, for a useful pyrotechnic application of this product. Among other properties, M. Böttger calls attention to that which this mixture possesses of being set on fire by the faintest electric spark, far surpassing in this respect the known mixture of equal parts of chlorate of potash and black sulphuret of antimony. The author observes, by the way, that the picrate of oxide of thallium detonates also very easily under a blow.—*Jahresbericht des Physikalischen Vereins in Frankfurt*, and *Dingler's Polytechnisches Journal*.—

Chrome Green.—Oxides of chrome are prepared either in the dry or wet way; obtained thus, they vary from greenish grey to a more or less deep greenish yellow. They generally have neither brilliancy nor freshness. It is possible, however, to produce green oxides of chrome which are not devoid of beauty. One of the most intelligent chemists of the commercial world, M. Casthelaz, has, conjointly with M. Leune, prepared a chrome green, which is justly styled imperial green. This colouring matter of a superior brilliancy is obtained exclusively by the wet way. The process consists in slowly precipitating chrome salts by treating them with hydrated metallic oxides, insoluble, or but slightly soluble, in water, or by hydrated metallic carbonates, or hydrated metallic sulphides, or, again, by other salts of weak acids, which easily leave their bases; the action is only produced progressively, and the oxide of chromium is precipitated in the hydrated form; the colour of the compound is magnificent, of a deep emerald green. For this preparation, it is convenient to adopt economical reagents, such as gelatinous alumina, oxide of zinc, carbonate of zinc, sulphide of zinc, &c., whose price is reasonable. The same result may be obtained by treating a chrome salt with the non-alkaline metals, which have a sufficient affinity to unite with the acid of the chrome salt and precipitate the oxide. Iron and zinc will be more particularly used, as they are cheaper. It is necessary to select from among the metals, with their oxides and salts, those which, with the acid of the chrome salt, give soluble salts, as they should be removed by washing. If recourse is had to reagents forming, with the acid of the chrome salt, insoluble salts, it is only in order to modify the colour and composition of the chrome precipitates and of the green colour thus formed. As to the magnificent imperial green colour obtained by M. Casthelaz, it possesses properties which will enable manufacturers ultimately to renounce the justly condemned and dangerous copper and arsenic greens. The use of the imperial green removes all danger from insalubrity; it is an impalpable substance, of perfect tenuity. It is believed that this property will cause the new green to be adopted for printing on stuffs, and for other purposes. The oxides of chrome known up to the present time, and generally obtained in the dry way, cannot, by pulverisation, attain to the degree of fineness of the imperial green. It is expected that this substance will have great success in oil painting, coloured papers, colours, and artificial flowers, printing, lithography, perfumery, and soap manufacture, as well as in the making of glass and in the ceramic arts.—*Moniteur Scientifique*.

PATENTS.

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3965. A. G. Gazalat, Rue Gaillon, Paris, "Improvements in the manufacture of steel, and in the apparatus employed therein."—Petition recorded December 30, 1868.

337. L. Wray, Ramsgate, Kent, "An improved process for carbonising and hardening wrought-iron."—February 3, 1869.

355. F. Braby, Camberwell, Surrey, "Improvements in the treatment and utilisation of the waste solution of sulphate of iron resulting from the cleansing of iron surfaces in the process of galvanising."—February 5, 1869.

419. P. Taysen, Leith, Scotland, "Improvements in the manufacture of stearic and oleic acids."—A communication from J. C. A. Bock, Copenhagen, Denmark.—February 10, 1869.

434. H. Edwards, Staple Inn, Holborn, "An improved preserved food."

442. W. E. Newton, Chancery Lane, "Improvements in the manufacture of explosive compounds."—A communication from A. Nobel, Paris.—February 12, 1869.

460. A. H. Lewis, Fenwick Street, Liverpool, "Improvements in extracting copper from its ores."—A communication from T. S. Hunt, Montreal, and J. Douglas, jun., Quebec, Canada.—February 15, 1869.

469. L. N. Legras, Wardour Street, Middlesex, "Improvements in the preservation and disinfection of animal and other substances, and in the apparatus employed therein."

473. C. E. Brooman, Fleet Street, London, "Improvements in treating the waste of wool, silk, horn, and other nitrogenised animal matters to be used as manure."—A communication from P. Pichelin, Orleans, France.

488. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved method of obtaining benzole and its homologous substances from coal gas."—A communication from H. Caro, A. Clemm, C. Clemm, and F. Engelhorn, Mannheim, Baden.—February 17, 1869.

NOTICES TO PROCEED.

3154. W. E. Gedge, Wellington Street, Strand, "Improvements in the manufacture or preparation of artificial fuel."—A communication from C. de Lin, and A. C. Dalma, Rue Blondel, Paris.—Petition recorded October 15, 1868.

3177. E. T. Hughes, Chancery Lane, "An improved adhesive substance."—A communication from J. Totin and A. Totin, Montreuil, France.—October 17, 1868.

3203. G. Chapman, Glasgow, N.B., "Improvements in treating sewage in order to obtain valuable products therefrom."—October 20, 1868.

3248. J. Baggs, High Holborn, "Improvements in smelting, carburising, and purifying iron."

3250. J. Spratt, High Holborn, "Improved preparations of food for horses, cattle, game, poultry, and other domestic animals, such preparations being capable of admixture with compounds for the production of a medicated food for man."—October 24, 1868.

275. N. C. Szerelmey, Belgrave Road, Pimlico, "Improvements in making tarpaulin in different colours, and in treating sail-cloth and other fabrics to preserve them from rapid destruction by the sea air and other corroding influences."—January 29, 1869.

NOTES AND QUERIES.

Guano of Mexillones contains, according to Bobierre's analyses, 33 per cent of phosphoric acid, equal to 71.5 per cent of tribasic phosphate of lime.

Silicated Hydrogen.—Mr. Freidel has just discovered that this gas is entirely decomposed by the electric spark, giving rise in the eudiometer to a shower of amorphous silicium of a brown colour.

Fibrin of Blood.—According to Messrs. Béchamp and Estor, the substance denominated fibrin of blood is only a kind of membrane formed by the microzymas of the blood associated or accompanied by a substance secreted by them by means of the albumenoid substances of the blood.

Aniline Black.—"New Berne" is referred for this matter to the CHEMICAL NEWS, August, 1866, p. 59, and to the volumes of Elsner's *Chemisch Technische Mittheilungen*, published annually since 1846, all of which may be inspected at the free library of the Commissioners of Patents.

Preservation of Hydriodic Acid.—This acid is kept and properly preserved in a white state in the presence of turnings of copper; the iodide of copper which is slowly formed is not dissolved by the acid; hydriodic acid which has become brown-coloured will be restored to its pure colour when shaken up with copper turnings.—*Deutsche Industrie Zeitung*.

Aniline Black for Cotton.—"New Berne" enquires in the "Notes and Queries" whether there is an aniline black for cotton. There is an aniline salt used in this district by many calico-printers which, treated with an oxidising paste made on purpose for it, produces a black considered the best out. If your correspondent will apply to S 48, Post Office, Manchester, he can learn all about it.

Atomic Weight of Lanthanum.—M. Zschiesche has prepared sulphate of lanthanum of such a purity that a thickness of 17 centimetres of a saturated solution gave no trace of the absorption bands of didymium. Working on this, he has found the atomic weight of lanthanum to be, from a mean of six experiments, 45.09. The extremes were 44.72 and 45.625.—*Journ. de Chim. Prat.*

Picrate of Quinine has been tried, according to the *Revue Maritime et Coloniale*, in the French Navy and some French settlements in Asia and Africa where a peculiar kind of ague was prevalent, but it has not been found to answer at all well, as it affects the digestive organs; besides this picric acid, although intensely bitter to the taste, is now considered not to possess any medicinal properties which would render it peculiarly valuable; its internal use tinges the skin yellow.

Action of Aqua Regia on Sulphur.—Mr. Lefort has studied the action of aqua regia upon sulphur and sulphur ores; he finds that at first there is a chloride of sulphur formed by the disengaged chlorine, but soon after this compound is again destroyed by the action of the nitric acid, and chlorine is set free, while sulphuric acid is formed. Lefort finds that the best proportion of the mixed acids most suitable for the rapid oxidation of sulphur is 1 part of hydrochloric and 3 of nitric acids, precisely the reversed proportion as used for ordinary aqua regia.

Mr. Sorby's Researches on Diamonds.—Mr. Sorby finds that the supposed cavities in diamonds described by Brewster are in reality enclosed crystals, and the conclusion arrived at from the consideration of the whole structure of the diamond is not opposed to its having been formed at high temperature. The crystals enclosed in diamonds are frequently seen to be surrounded by a series of fine radiating cracks, which are proved to have been the result of the contraction suffered by the diamond in solidifying over the enclosed crystal, and this explanation has been artificially verified by examining crystals formed in fused globules of borax glass, cooled slowly, when the same phenomena are seen.

Assay of Gold Quartz.—First let the rock containing gold be roasted at a red heat, as is practised with regard to flints intended for pottery ware manufacture; this roasting renders it easy to break the rock afterwards into small pieces. In this state the rock should be placed in a large earthenware (fire-clay) tube fixed in a furnace in a manner similar to the large fire-clay retorts used in the manufacture of gas (double retorts), open at both ends and projecting beyond the furnace on each end; the heat in the interior of the tube should be bright cherry-red. If, under these circumstances, a current of chlorine gas be passed through the retort, the gold contained in the rock will combine at the high temperature with the chlorine, and become volatile therewith, whereas at the place where the heat of the tube or retort is less high, the chloride of gold will become again decomposed and gold deposited.

Will Steam Ignite Combustible Substances?—This curious question is discussed in a recent number of the *Scientific American*. It is urged that as the heat generated by a hydrocarbon in combination with a combustible fibre will produce combustion, and as a fibrous material saturated with oil will, if exposed to the sun's rays, burst into flame, it follows that a greater degree of heat, whether produced by steam or any other agency, may produce like results. After mentioning the inflammable condition acquired by wood through which a steam pipe has been passed, it is remarked that every engineer of some experience and close observation knows that it is possible to ignite combustible or inflammable substances by the direct impact of steam. Cases are on record where dry wood was ignited by escaping steam, and, as an experiment, oil-saturated cotton waste and dry pine wood have been lighted by the steam from a boiler at a distance of 12 feet, the pressure of the steam being at the time only 95 lbs., and the temperature of the steam, inside the boiler, not at 12 feet distance thereof, 335° F.; the material burst into flame in a few minutes. I witnessed many years ago a case where a quantity of racine, *i.e.*, madder root not yet ground, took fire simply by being heated up to about 210° F. by means of the waste exhaust steam from a small high-pressure steam-engine being made to pass through a series of pipes, above which the racine was placed on an iron grating in a layer some 4 inches in thickness.—Dr. A. A.

MEETINGS FOR THE WEEK.

MONDAY, March 15th.—Medical, 8.

London Institution, 6.

TUESDAY, 16th.—Royal Institution, 3. Rev. F. W. Farrar, "On Comparative Philology."

WEDNESDAY, 17th.—Society of Arts, 8.

Meteorological, 8.

THURSDAY, 18th.—Royal Institution, 3. Dr. H. Power, "On the Eye."

Royal, 8½.

Zoological, 4.

Chemical, 8. Arthur Elliott, "On the Determination of Carbon in Cast-Iron." E. T. Chapman, "On Butylic Alcohol."

FRIDAY, 19th.—Royal Institution, 8. Dr. Crum Brown, "On Chemical Constitution."

Quekett Microscopical Club, 8.

SATURDAY, 20th.—Royal Institution, 3. Dr. Odling, "On Hydrogen and its Analogues."

** Owing to press of matter, our answers to correspondents are unavoidably postponed till next week.

THE CHEMICAL NEWS.

VOL. XIX. No. 485.

ON THE CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(ADAPTED TO A JUVENILE AUDITORY),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN,
(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, Esq., M.B., F.R.S.

(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE VI.

CARBONIC DISULPHIDE—CARBON—CARBONOUS OXIDE—
CARBONIC GAS.

Burning of charcoal in sulphur vapour, to form carbonic disulphide; ready changes of carbonic disulphide from gaseous to liquid, and from liquid to gaseous state, by alterations of pressure—Absorption of heat, or production of cold, by vaporisation of liquid carbonic disulphide—Analogies of gaseous carbonic disulphide and carbonic gas—Great weight and ready inflammability of carbonic disulphide vapour—Its brilliant combustion in current of oxygen and when mixed with nitric oxide gas—Liquid carbonic disulphide heavier than, and immiscible with, water—Its dissolution of iodine, with assumption of deep purple colour—Unburnt carbon, or charcoal, the characteristic constituent of vegetable tissue—Ready burning of charcoal and wood in air or oxygen, with production of carbonic gas—Destiny of unburnt charcoal to become oxidised or burnt at some time or other—Carbon burnt into carbonic gas in processes of respiration and decay—Partial unburning, or deoxidation, of carbonic gas into carbonous oxide by ignited iron—The re-burning or re-oxidation, of carbonous oxide into carbonic gas attended by a great development of heat—Unburning of carbonic gas into carbon by ignited sodium—Partial unburning of carbonic gas into carbonous oxide and oxygen, effected by heat of the electric spark and of the oxyhydrogen blowpipe—Re-burning of separated carbonous oxide and oxygen into carbonic gas—Disappearance or absorption of heat in the unburning, and reappearance or evolution of heat in the re-burning—Complete unburning of carbonic gas into carbon and oxygen in growing plants exposed to light and heat of the sun—Oxygen of unburnt carbonic gas discharged by growing plants into the air—Carbon of unburnt carbonic gas transformed by growing plants into woody fibre, starch, sugar, &c.—Disappearance or absorption of the sun's heat in the unburning of carbonic gas effected by growing plants—Reappearance or evolution of the sun's heat in the re-burning of wood and charcoal into carbonic gas.

You will remember that when a diamond is made exceedingly hot, it is converted into a mass of graphite, or plumbago, or black-

lead, these three terms meaning the same thing. Now as black-lead, or plumbago, or graphite, is nothing more than charcoal, and as diamond can be converted into black-lead, it follows that diamond is in reality charcoal. But we know this in another way; when we burn a diamond, we find that the only substance it yields is burnt or oxidised carbon—in other words, carbonic gas. I will now show you once more the burning of the diamond. In this globe of oxygen gas is a diamond, surrounded by a piece of platinum wire; this wire I will make red-hot, and it will communicate its red heat to the diamond. As soon as the diamond is thus made red-hot, it will burn in the oxygen gas. [The experiment was performed as described.] The diamond has now begun to burn. You see its brilliant glow in the globe of oxygen, as it is being slowly consumed. I take away the platinum wire, but the diamond continues hot quite independently of it, and gives a bright spot of light, which is due to its strong ignition and to the fact that it is actually burning. The diamond is being converted into burnt or oxidised diamond, or into burnt or oxidised charcoal; and we may test this in an instant by introducing a little lime-water, which we thus convert into a mixture of chalk and water, chalk being the compound formed by the combination of burnt carbon, or burnt diamond, with lime. I shake up a little lime-water in the globe, and though, for obvious reasons, I have not burned a very large diamond, yet I have obtained this carbonic gas, or oxide of carbon, or burnt carbon, by means of which I have converted our lime-water into a mixture of chalk and water. This effect, I think, is visible all over the theatre.

We have now considered a great many of the changes of carbon or charcoal. We have considered the change of charcoal into black-lead, the change of diamond into black-lead, and the change from black-lead back again into charcoal; also the change of charcoal, of black-lead, and of diamond, into burnt charcoal or carbonic gas. We have likewise considered indirectly the conversion of certain compounds of carbon and hydrogen into carbon, in the imperfect combustion of coals, candles, and similar substances.

I want now to call your attention to some other changes which charcoal is capable of manifesting, amongst which is the change it undergoes in its combination with this substance—sulphur or brimstone.

We usually see sulphur as a solid substance—in the form of sticks or rolls; it is somewhat brittle, but is very easily brought into a liquid state. If we heat it, it melts like a piece of ice, and yields liquid sulphur, just as the melting of a piece of ice yields water. If we heat the

* Reported verbatim, by permission of the Author, for this Journal.

sulphur still further, it will boil just like water, and in that way we obtain sulphur gas, which is a vapour of a deep orange colour. Here is some sulphur which is at present liquefied; in a minute or two it will boil, and then the flask containing it will be full of the vapour of sulphur, which you will recognise by its deep orange colour. Just now the vapour is scarcely visible, for the sulphur does not yet fairly boil; it is now beginning to do so, and soon you will see the flask filled with a deep orange-coloured and perfectly transparent gas or vapour. This gas, or vapour is characterised by its considerable weight, by its dark orange colour, and by the facility with which it is changed back into the liquid state; wherein it differs from oxygen gas, although in some respects it corresponds very closely with it. You will remember that not only do ordinary combustible substances, such as coals or candles, burn in oxygen gas, but certain metals also. I showed you the combustion in oxygen of zinc and of iron; I will now show you the burning of some metals in this vapour of sulphur, and you will see that they burn in it very much the same as in oxygen. I take a piece of copper, and first warm it a little; I then introduce it into the sulphur vapour, and you see that it burns very completely, just as our piece of iron did in oxygen. You see that when I introduce the piece of copper into the sulphur vapour, the copper becomes brilliantly hot, and gradually consumes in the interior of the flask, which gets filled with this deep-coloured vapour. In this particular, sulphur vapour corresponds very closely with oxygen. Now, will a piece of charcoal burn in this deep orange-coloured sulphur-gas or vapour, which is now quite visible? I light a piece of charcoal: if I put it into a globe of oxygen it would burst into a flame; but when I put it into sulphur vapour it is immediately extinguished—it will not burn in sulphur. Nevertheless, it can be made to enter into combination with it; that is to say, if, instead of trusting for the necessary amount of heat to the burning of the charcoal in the sulphur vapour, we heat the charcoal strongly, and keep it strongly heated whilst in the sulphur, then the carbon and the sulphur will enter into combination one with another. When iron and oxygen burn, we get oxide of iron; sulphur and copper burnt together yield disulphide of copper, just as by combining copper with oxygen we obtain oxide of copper. Now, if we introduce the heated charcoal into sulphur vapour, and burn it there by keeping it hot, we get disulphide of carbon.

What is the nature of this disulphide of carbon? In the first place, ordinarily a liquid. Here we have some specimens of it. You will remember that the carbonic gas can be

liquefied, and I showed it to you in that state; in the same manner we can gasify disulphide of carbon. This tube, which looks as if it were empty, contains some of the gas of disulphide of carbon. This gas is very easily reduced into a liquid state; if I allow the ordinary weight of the atmosphere to press upon it, the mercury will rush up the tube, and some of the vapour will be converted into liquid. By putting on a little pressure from my mouth, I can convert the whole of this gas into liquid. [The pressure of the atmosphere was allowed to operate on the contents of the tube.] You see the mercury already begins to rise, showing that we have converted a considerable quantity of our disulphide of carbon gas into disulphide of carbon liquid. By blowing into the tube with a little force, I shall be able to push the mercury up to the top of the tube, and by that additional pressure the whole of the disulphide of carbon gas will be converted into a liquid, just as by means of an iron vessel I was able at the last lecture to pump a great quantity of carbonic gas into the interior of the vessel, and so obtain it in a liquid condition. You will notice that when, through my blowing, the mercury reaches the top of the tube, it will strike it with a slight noise, which many of you will be able to hear. This disulphide of carbon, then, we may regard as a substance which is sometimes in the liquid state, with a strong tendency to become a gas or vapour, and sometimes in the gaseous state, with a strong tendency to become a liquid.

Now for some of the properties of this compound when in the liquid state. I ought to warn you that disulphide of carbon, whether a liquid or a gas, is characterised by a somewhat disagreeable odour. Perhaps on this account I ought not to bring it before you, but it has properties so remarkable in many respects that I cannot refrain from introducing it. First with regard to its weight. It is very much heavier than water; to show you how heavy it is I will pour some of it into this water. In these experiments I usually colour the water blue or red, to render it visible to you, but in this instance I have coloured it brown by using iodine for reasons which you will presently understand. I pour some of this disulphide of carbon through the brown water, and you see it at once falls to the bottom; and something else also happens. The liquid poured into the brown water was colourless, but now that it has fallen to the bottom through this brown liquid it has become decidedly pink in colour; but there is something more. I shake the two liquids up together, and you will find, I think, that the disulphide of carbon will take away all the brown colour, and instead of itself becoming brown it will become pink. It is a very curious circumstance with regard to

this iodine, that it dissolves in some liquids forming a brown liquid, but that on dissolving in disulphide of carbon it forms a deep pink. The disulphide of carbon has fallen to the bottom and assumed its beautiful crimson colour, and I think we shall find that by the time it has quite settled we shall have two distinct layers of liquid, and the upper one will be colourless. You will observe how colourless the supernatant water will eventually become. Disulphide of carbon is heavier than water, in the proportion of about thirteen hundred to a thousand; that is to say, if we were to take a volume of water which weighed a thousand grains or a thousand pounds, and the same volume of this disulphide of carbon, we should find the disulphide of carbon weighed thirteen hundred grains or pounds. But, although this substance is heavier than water, it is not so heavy as a saturated solution of salt. [This fact was illustrated by a small quantity of a saturated solution of salt being placed at the bottom of a vessel of disulphide of carbon, and there remaining.]

Now for another property of this disulphide of carbon. It consists of sulphur or brimstone, and charcoal, and both brimstone and charcoal are very combustible or easily burning bodies; and the fact that the brimstone and the charcoal are in combination instead of being separate, does not at all interfere with their combustibility. Accordingly, if I moisten a sponge with a little disulphide of carbon, and bring it to the flame, you see that it at once burns with a lambent blue flame. There are two or three very interesting points connected with the combustion of this substance. When it burns, and there is sufficient air, the charcoal is converted into oxidised or burnt charcoal, in the form of carbonic gas, and the sulphur into oxidised sulphur or sulphurous gas. But if there is not sufficient air what will happen? The charcoal only will be burnt. You will remember that when we took an ordinary candle, or a gas flame, and cut off the supply of air, the hydrogen only was burnt and not the charcoal. In the present case when the supply of air is insufficient for perfect combustion, the charcoal burns and the sulphur does not. That is one interesting point connected with the burning of disulphide of carbon. The other is, that it is one of those substances which are ignited with the greatest ease. I have here an ordinary test tube containing a little olive oil. I heat this up to a temperature a long way short of red heat—a temperature which corresponds to about four hundred degrees Fahrenheit, or about twice as high as that of boiling water. The tube of oil being sufficiently hot, I will place it in the disulphide of carbon vapour, and I want to show you that with that tube of hot olive oil I shall be able to set fire to the disulphide of carbon.

I will pour a little of the substance into these glasses, and then try to ignite it, not by a match or a lighted taper, but simply by this tube of heated oil. [Disulphide of carbon vapour was inflamed by the tube of hot oil.] You see that we can readily set fire to this substance by means of a little heated oil. It is, in fact, one of the most easily combustible of all the common substances known to chemists. It gives off vapour, or becomes vapourised, very easily and very quickly, and, moreover, the gas or vapour of the disulphide of carbon is very heavy. It is much heavier than carbonic gas which I showed you in a previous lecture, for whereas carbonic gas is only about one and a half times as heavy as air, this is two and a half times as heavy. I will give you an illustration of these two points together—the great facility with which this substance is converted into vapour and the heaviness of its vapour; and then, thirdly, I will illustrate to you its inflammability. I have here a piece of sponge moistened with the disulphide; I put it at one end into the corner of this long flat box, and under these circumstances it will give off vapour. I want to see at what distance I can light the vapour which is given off from the moistened sponge. The vapour will doubtless fill the box, and I shall be able to ignite it from the extreme end or corner of the box. I approach the flame carefully with the light, and when the vapour is lighted, it shrinks at once to the other end. You see that it is very easy to ignite, and difficult to extinguish. I will now give you some further illustrations of the heaviness of this disulphide of carbon. Here I have a bottle apparently empty, but really containing disulphide of carbon gas. I will pour a little of this heavy gas into this tall jar, just as the other day I poured the carbonic gas. I take our apparently empty bottle, and having poured the gas from it into the jar I apply a light and ignite the gas. Now we will see whether we cannot go a little farther. We have now two glasses; I take the bottle containing the disulphide of carbon vapour, and fill this first glass with it. I now pour some of the gas from the first into the second glass, into which I put a light, and you see the gas takes fire. I will repeat the experiment, using three smaller glasses instead of the two larger ones. I take the bottle of gas, and begin by filling this first glass; I transfer a portion of the contents of the first glass into the second, and next I pour a portion of the gas from the second glass into the third. Now we will see whether all these three glasses contain this inflammable gas. [A lighted taper was applied successively to the third, second, and first glasses, and in each instance the presence of the disulphide vapour was manifested by its ignition on contact with the flame.] We might go on in this

way ; indeed, I have extended the experiment to as many as four or five glasses. Now I have here a glass barrel, which is apparently empty, but really containing this disulphide of carbon vapour, and so heavy is the vapour that I shall be able to draw it out from the tap of the vessel. I hold a beaker under the tap, and so draw into it a little of the vapour. Our beaker being sufficiently full for our purpose, I turn off the tap, and on bringing a light near the beaker, the gas contained in it takes fire. I will give you one more illustration of the weight of this disulphide of carbon. You know it is a very common practice to draw off liquids by means of a syphon, and I will try whether this can be done in the case of this vapour. I insert one end of the syphon in the vessel of vapour, and fill the syphon in the ordinary way by sucking it. Our syphon is now full, and the gas issues from the end of it. I hold these vessels under the syphon in order to receive the gas which is flowing from the end of it, and you see that I can thus catch the gas, and then I shall be able to set it on fire.

I have given you several illustrations of the facility with which this substance is converted into vapour, and also of the inflammability of the vapour. I want now to show you that if I vapourise it more rapidly, which may be done in a current of air, I can produce a great amount of cold. In my last lecture I showed you the amount of cold that could be produced by the vapourisation of the liquefied carbonic gas. Now I want to show you the amount of cold that can be produced by the vapourisation or gasification of liquid carbonic disulphide. I pour some water on the top of this stool, and then place the beaker on the wet part. I next pour some disulphide of carbon into the beaker, and blow a current of air upon it. By this means our disulphide of carbon is very quickly converted into vapour. It is now rapidly vapourising, at the same time producing a very intense cold, and I have no doubt that in a minute or two this beaker will have become so firmly frozen to the stool that I shall be able to hold up the latter by means of the beaker, just as I did the other day when illustrating the cold produced by the spontaneous vapourisation or gasification of the solidified carbonic gas. You will remember that in that case I allowed the vapourisation to take place spontaneously. In the present instance I cause the vapourisation by a current of air which is being blown upon the liquid from below. [After a short interval the glass beaker was found to be frozen to the top of the stool.] It is now frozen, but I will allow it to remain a little longer so as to make sure that it is frozen sufficiently firmly to allow me to hold up the stool by the glass. [After a short pause]—Here you see I am lifting up the stool by the beaker; the two adhere so

closely that it requires some considerable force to separate them.

In the experiment just performed I vapourised some disulphide of carbon simply by blowing air upon it; but now I am going to boil it, and I want to show you what a beautiful and extensive flame may in this way be produced. It is a liquid which both boils and vapourises very quickly. It is beginning to boil, and you see the beautiful lambent flame with which it burns. I now turn on a supply of oxygen, and in this I burn the disulphide vapour. I want you for an instant to form an idea of the length of this brilliant and peculiar blue flame; but I must not let it burn long, because it produces a great deal of sulphurous gas, which is very unpleasant.

The last property of this disulphide of carbon to which I wish to call your attention is the mode in which it burns, not in oxygen or in air, but in another gas which I have not hitherto considered in my lectures on carbon, namely, an oxide of nitrogen, and I will show you the very brilliant manner in which the disulphide of carbon will burn in it. Here we have a cylinder of the gas, and here, in this small glass globe, is our disulphide of carbon. I let the disulphide of carbon globe fall to the bottom of the jar, and, of course, in doing so it breaks, as you see, and I shake it up with the other gas. [The mixture was then ignited, and produced a very brilliant flash of light]. This is the last experiment that I have to show you with this liquid or vapour, which, although very interesting, is very disagreeable in many respects.

(To be continued).

ON THE CRYSTALLISATION OF IRON.

DURING an examination of the Heaton process for making steel at Langley Mill, in which I have been lately engaged for the purpose of reporting thereon, I noticed a remarkable instance of the crystallisation of iron. After the violence of the action between the molten iron and the nitrate of soda has subsided, the lower portion of the apparatus, called the converter, is detached, and after a few minutes the contents are turned out in a porous mass of nearly $\frac{3}{4}$ of a ton in weight on to the floor. Upon examining portions of this metallic sponge, I find it consists of a segregation of minute feathery crystals of iron, apparently built up of small cubes. The outlines of some of these are perfectly sharp, and their appearance, especially in the cavities, is very beautiful.—W. CROOKES.

Alizarine.—Mr. Martin, taking advantage of Schützenberger's investigation of madder, has invented a process for transforming orange-madder, purpurine, pseudo-purpurine, and xantho-purpurine into alizarine. The several colouring matters are first dissolved in concentrated sulphuric acid; next, powdered zinc is added, and heat applied: when the reaction is completed, the mass is diluted with water; an abundant precipitate falls, which is the required dye; this after washing with water is ready for use.

ON THE
IMMEDIATE ANALYSIS OF DIFFERENT
VARIETIES OF CARBON.

By M. BERTHELOT.

(Continued from page 113.)

GRAPHITIC oxides and their derivatives form a special group, quite distinct from the ordinary combinations of organic chemistry. Let us now inquire what are the relations between these two sorts of compounds, and whether they are to be explained within the circle of analogies drawn from the study of other hydrocarbon compounds.

The transformation of graphitic compounds into ordinary organic compounds, say, carbides of hydrogen, is easily effected by heat and electricity; the different carbons and graphites, under the action of the electric arc, combine directly with hydrogen, and produce acetylene, a true organic compound capable of directly forming all the other organic compounds properly so-called.

Carbides of hydrogen may also be formed with graphites by working with carefully managed reactions at a temperature not exceeding 280° . The same treatment must be used as with amorphous carbon, instead of working on the pure carbon, which cannot be combined at a low temperature with free or nascent hydrogen; begin by oxidising the carbon, and then introducing the hydrogenising action of iodhydric acid.

The oxides thus formed do not immediately produce carbides of hydrogen with the hydracid, which only changes them into hydrographitic oxides possessing special properties; but pyrographitic oxides, which are easily prepared by heating graphitic oxides, are nearer than these latter to the state of amorphous carbon, and therefore more easily oxidised or hydrogenised. By heating to 280° pyrographitic oxide from plumbagine with 80 parts of iodhydric acid, I obtained hydrogen containing six hundredths of marsh gas. To ascertain the nature of the carburetted gas, I treated the gaseous mixture with absolute alcohol, determined the quantity dissolved, and made a comparative analysis of the gas undissolved and that dissolved, then re-evolved by ebullition, the latter consisting of a mixture of 36 parts of marsh gas and 64 of hydrogen. A suitable calculation founded upon the previous experiments, and upon the co-efficients of solubility, proved that the gaseous carbide was really marsh gas, C_2H_4 . However, the whole substance does not undergo the change which produces the marsh gas; a considerable portion remains under the form of a black carbonaceous powder; the composition of this powder is also changed, for, when subjected to heat, it evolves a small quantity of inflammable vapour, which appears to be acetone. An addition of nitric acid and chlorate of potash will change this powder entirely into soluble products, with the exception of from 1 to 2 thousandths of graphitic oxide.

Pyrographitic oxides derived from cast-iron and electric graphite behave in exactly the same manner.

These facts show at once the speciality of constitution which distinguishes graphitic oxides from other organic combinations, and the conditions under which that speciality is gradually effaced, until the common order of combinations is regained. The difference must not, however, be exaggerated; it strikes us the more forcibly because we are led to compare graphitic oxides with gaseous or volatile hydrocarbons; this is not, in my opinion, the true mode of comparison. In the first place, the products of oxidation of graphites do not wholly differ from those of oxidation of amorphous carbon; both are fixed, and represent very condensed bodies; only the carbonic products are soluble, and the others insoluble. The passage from the characteristics of one group to those of the other becomes very apparent upon examining certain oxidised compounds derived from amorphous carbon; for

instance, those derived from carbon produced by treating benzene or naphthalene with iodhydric acid. These products are dark yellow, amorphous, and precipitable by salts from their solution or aqueous emulsion, and are the intermediary compounds between graphitic oxides and those of amorphous carbon. These latter present much similarity to the products of oxidation of ulmic matter and other analogous condensed compounds.

The properties of graphitic oxides are not without analogy; their brisk decomposition is accompanied by the same formation of water and carbonic acid as in that of fixed acids and other highly oxygenated organic compounds. The lively evolution of heat which occurs at the same time may also be observed, though less intense, in the pyrogenated decomposition of acids and hydrates of carbon. Graphites, amorphous carbons, and their derivatives, may therefore be most suitably compared to hydrates of carbon and ulmic matter. In the series of gradual decompositions to which organic principles may be submitted, when decomposition occurs by molecular condensation, the brown and ulmic compounds immediately precede the carbonaceous substances, which appear still more condensed, and these again precede the carbons properly so-called. The special structure of these compounds is demonstrated not only by their origin, but also by the hydrogenising action of iodhydric acid, which reproduces saturated carbides corresponding with their generators, either the carbonaceous matters themselves, or the products of their oxidation.

The different varieties of amorphous carbon represent, therefore, certain polymeric conditions of the true carbonic element as it exists in the most widely disseminated hydrocarbonated combinations. The same conclusion applies to the different graphites. I shall show in my next that the most simple compounds of carbon are divided into two groups, according as they reproduce by their decomposition amorphous carbons properly so-called or graphitic carbons. All these substances must then be polymeric with the true carbonic element, as yet unknown, supposing it to exist in a free state and in a non-condensed form similar to that of the gaseous elements.—*Comptes Rendus*.

ON THE
NON-PRECIPITATION OF MANGANESE
BY
SULPHIDE OF AMMONIUM IN PRESENCE OF
SOME ORGANIC AMMONIACAL SALTS.

By Prof. HOW, D.C.L., Windsor, Nova Scotia.

IN conducting the process of Reynolds (*CHEMICAL NEWS*, vol. ii., p. 208), for the separation of iron and alumina, by precipitating the former metal by sulphide of ammonium after addition of oxalic acid, I found that some of the manganese present remained dissolved along with the alumina. Unprepared for this retention, and failing to find any information as to the behaviour of manganese with sulphide of ammonium in presence of organic acids, I was led to experiment on this subject, and now give such of my results as seem to possess novelty and interest.

The oxalate of manganese recently described by myself (*CHEMICAL NEWS*, vol. xix., p. 41), appears to be much more soluble in dilute hydrochloric than in dilute sulphuric acid, and hence, doubtless, oxalic acid does not throw down the salt so soon or so abundantly from the chloride as from the sulphate of the metal. If a large quantity of oxalic acid is used with the chloride, and excess of ammonia and some sulphide of ammonium are quickly added, no sulphide of manganese falls, but the characteristic needles of the oxalate soon appear. When chloride, oxalate, and sulphide of ammonium are successively added to chloride of manganese, both sulphide and oxalate of this metal fall after a short interval. When

the oxalate is dissolved in dilute HCl, successive addition of oxalic acid, ammonia, and sulphide of ammonium gives no precipitate of sulphide; and, on standing, crystals, consisting, no doubt, of an oxalate, are formed—perhaps the double salt mentioned by Gerhardt, and alluded to in my paper above cited. When solid tartaric acid is warmed in solution of MnCl_2 , the subsequent addition of ammonia and sulphide of ammonium causes no precipitate. The same result is obtained when citric acid is employed. In both cases no manganese is thrown down on standing twenty-four hours.

The other metals of the fourth group fall, either at once or after a short time, as sulphides when the before-mentioned solutions retaining manganese dissolved in presence of sulphide of ammonium are added to their salts formed with mineral acids.

It does not appear that attention has been given to the deportment of manganese now described. Fresenius says the metal may be precipitated as sulphide from all compounds without exception (Quant. Anal., third English edition, p. 169), and mentions sulphide of ammonium as the proper precipitant (p. 170). H. Rose points out that manganese is not completely thrown down as sulphide, especially in liquids containing salts of ammonia (CHEMICAL NEWS, vol. ii., p. 302), but he makes no mention of organic acids.

From the fact that oxalic and tartaric acids do not prevent the precipitation of sulphide of manganese by sulphides of the fixed alkaline metals, it seems that the joint presence of these acids and of ammonia (only) is necessary to retain the metal in solution on addition of sulphide of ammonium. I find that citric acid, dissolved in solution of MnCl_2 , prevents precipitation on addition of potash and sulphide of potassium, and such solution, after standing twenty-four hours, precipitates sulphide of nickel from the nitrate of the metal immediately on its addition.

It would be interesting to enquire whether the retention of manganese now described depends on the production of manganos-ammonium, mentioned by Gerhardt, and alluded to in my paper on the oxalate of manganese referred to above.

ON FOOD.*

By DR. LETHEBY, M.A., M.B., &c.

(Continued from p. 91.)

Unwholesome and Adulterated Food.

As regards vegetable foods, they are not so liable to decay or even to parasitic infection as animal foods; for the acari or mites of flour and sugar, or even the weevils of biscuit are harmless; indeed, the most important infection of grain is the fungoid disease of it, called ergot. This is the muttercorn or roggemutter of the Germans, and as it chiefly infests the rye, it is named, from its appearance, spurred rye; but it also attacks barley, oats, wheat, maize, rice, and most of the grasses. It always appears as a black grain, of a larger size than usual, and it is mostly found in plants which grow upon moist clay soils, in damp situations, especially in the neighbourhood of forests. The district of Sologne, in France, between the rivers Loire and Cher, was once notoriously infested with the disease, and the Abbé Fessier, who was deputed in 1777 to investigate the causes of the extraordinary prevalence of ergot in that district, attributed it to the poorness and wetness of the land, and to the dampness of the air from the numerous forests. In bad seasons, as much as a third or a fourth of the crop was infected with ergot, and even in good seasons it constituted about two per cent of it. The disease in the grain is due to the growth of a peculiar fungus, which the late Mr. Quekett named *ergotetia abortifaciens*, and the effects of it on the human

body are very serious. It acts chiefly on the nervous system, causing giddiness, dimness of sight, loss of feeling, and twitching of the limbs, and death by convulsions; or it produces a creeping sensation over the surface of the body, with coldness of the extremities, followed by insensibility and gangrene. These effects are no doubt referred to by Ligebert in his "History of Gaul and France," when he says that the year 1089 was a pestilent year, especially in the western parts of Lorraine, for many persons became putrid in consequence of their inward parts being consumed by St. Anthony's fire. Their limbs were rotten, and became black like coal, and they either perished miserably, or, being deprived of their putrid hands and feet, were reserved for a more miserable life. Bayle, too, in his account of this sickness, says that the bread was of a deep violet colour. The like effects have been observed in other parts of the Continent, as in Silesia, Prussia, Bohemia, Saxony, Holstein, Denmark, Switzerland, Lombardy, and Sweden, where the creeping sickness, as it is called, has attacked whole districts of the country, sparing neither old nor young, rich nor poor.

The remedy for the disease is in the hands of the miller, who should separate the ergotised from the healthy grains. Fortunately we have a ready test for its presence, not merely in the microscopic appearances of the flour, but in the circumstance that as it is the lightest of all the constituents of flour, it will float upon a mixture of one part of chloroform and six of alcohol, and will appear as a scum of dark-brown particles.

Another source of danger is the presence of poisonous grasses in the flour. The most important of these is darnel (*lolium temulentum*), which the careless or slovenly farmer will sometimes permit to overrun his fields, and the seeds becoming mixed with the corn, are ground into flour by the equally careless miller. The effect of the grains on man is to cause a species of intoxication, with headache, giddiness, somnolency, delirium, convulsions, paralysis, and even death. Occasionally it excites vomiting, with irritation of the alimentary canal, and then its effects are not so serious. Many instances are recorded of the poisonous action of the flour. Christison, for example, tells us, that a few years ago almost all the inmates of the poor-house at Sheffield, to the number of eighty, were attacked with analogous symptoms, after breakfasting on oatmeal porridge, and it was supposed that the effects were caused by the presence of darnel in the oatmeal. A similar accident is mentioned by Perleb, as having occurred at the House of Correction at Freyburg, and still more recently the same effects were produced on seventy-four persons at the workhouse of Beninghausen. Dr. Taylor states, on the authority of Dr. Kingsley, of Roscrea, that in the month of January, 1854, several families, including about thirty persons, suffered severely from the effects of bread containing the flour of darnel seeds. Those who partook of the bread staggered about as if they were intoxicated, and although they all recovered, yet they experienced a good deal of distress from giddiness, coldness of the limbs, and great prostration of vital power.

Unripe grain, as well as grain affected with the rust, and mouldy flour and mouldy bread, have also produced disturbance of the human system. M. Bouvier attributed the epidemic of dysentery, which occurred in the department of the Oise, in the autumn of 1793, to the use of unripe grain; and corn affected with brown or black rust is thought by many to be unwholesome. Mouldy flour or mouldy bread is certainly injurious, for several instances are on record where not only men, but horses, have been poisoned by mouldy bread; and M. Payen has given a graphic account of the distressing effects of the mouldy ammunition bread supplied to the troops who were encamped near Paris, in 1843; the mould on that occasion was a yellow fungus, the *oidium aurantiacum*, but at other times it has been of a green colour, from *penicillium glaucum*.

Mouldy food of every description is dangerous to use,

* The Cantor Lectures, delivered before the Society of Arts.

and considering to what an extent the spores or sporidia of poisonous fungi are floating in the atmosphere, it is surprising that they do not more frequently taint our food and cause disorder of the system, for air washed with distilled water will always yield abundance of these germs, which are ready at any moment to spring into activity when they come into contact with a proper nidus for their growth. A remedy for these hidden sources of danger is good and effective cooking.

And now, in conclusion, let me make a few remarks on the subject of the fraudulent sophistications of food—a subject which has been very popular for the last fifty years, or rather, I should say, since the year 1820, when Mr. Frederick Accum published his treatise on “Adulterations of Food, and Culinary Poisons,” with the startling motto from the Book of Kings—“There is death in the pot.” As you may easily imagine, such a terrible announcement by a well-known writer, could not fail to excite alarm in the public mind, and to provoke anxious curiosity. The book, therefore, was eagerly sought for, and a thousand copies of it were sold within a month of its publication; so that, to use the words of the author, in his advertisement to the second edition—“there was sufficient inducement to reprint the work.” The singular success of Accum’s undertaking has been such a temptation to others, that the press has literally groaned with the efforts of sensational writers on this subject. And although I am ready to admit the importance of it, yet I am bound to state that it has often been grossly exaggerated, especially by those who have had but little practical knowledge to guide them.

The objects of fraudulent adulterations of food are three-fold:—

1. To increase the bulk or weight of the article.
2. To improve its appearance.
3. To give it a false strength.

Among the first of these adulterations are the following:—

(a). The addition of inferior starches, as potato-starch or English arrow-root, curcuma or East Indian arrow-root, jatropa or Brazilian arrow-root, tacca or Tahiti arrow-root, canna or Tous-les-mois starch, sago-meal, &c., to true maranta, or West Indian arrow-root—of which Bermuda arrow-root is the most esteemed variety. A microscopic examination of the starch or fæcula will always discover the fraud.

(b). The mixture of starch-sugar or even starch itself with common cane-sugar. Starch-sugar, or as it is sometimes called, grape-sugar, or glucose, is manufactured both in this country and on the Continent to a considerable extent. It is made from any description of starch, by boiling it for half-an-hour or so in water containing about one per cent of sulphuric acid. The acid is then neutralised with chalk, and the liquor evaporated to a density of 1.28. While hot, it is run off clear from the insoluble precipitate of sulphate of lime, and on standing in a cool place for a few days it crystallises or sets into a solid mass. This description of sugar has a low sweetening power—not half so great as that of cane-sugar—in fact, it is produced from the latter by the action of vegetable acids and heat, when cane-sugar is added to fruit in making a tart or fruit pie, and in making jellies and jams. It is false economy, therefore, to sweeten to any extent before the tart is baked. The sugar is known by many characters, as a want of sparkle from the absence of well-formed crystals, its less solubility in water and greater solubility in alcohol, and by its giving a deep port-wine tint to a solution of potash when it is boiled with it.

(c). The dilution of milk, vinegar, &c., with water. This fraud is easily detected by the specific gravity of the liquid, and, in the case of milk, by the proportion of cream in the lactometer, and by the poor appearance of the milk when under the microscope.

(d). The mixture of dripping and other fats with butter, and water and starchy matter with lard. Butter and

lard should always furnish, when melted, a clear-looking oil, with but little deposit of water or other substance.

(e). The addition of gelatine to isinglass, which is sometimes so well managed that it requires a skilful analysis to detect it. Isinglass is an organised substance, and when examined with the microscope, exhibits a peculiar structure which is very characteristic of it; not so, however, with gelatine. A particle of isinglass put into cold water remains opaque, like a piece of white bread, and does not swell out, whereas gelatine becomes transparent, and enlarges a good deal in bulk. Jelly made from good isinglass has a slightly fishy smell, and is neutral to test-paper, but that from gelatine has a distinct odour of glue and an acid reaction. Lastly, if a few grains of isinglass be burnt in a metal spoon until the ash alone remains—the ash will be very small in quantity, and of a reddish colour, while that of gelatine will be much larger in amount and of a white appearance. Gelatine never agrees with the delicate stomach of an invalid like isinglass; and, therefore, it is often important to discover the difference.

(f). Coffee adulterated with chicory is readily detected by sprinkling the mixture upon water, when the coffee, which is slightly greasy from volatile and fixed oil, floats while the chicory sinks, and gives a brownish tint to the water. The experiment is easily made, as you here see, in a tumbler of water, and you may, with a little tact, determine the proportions of the mixture.

(g). Wheaten flour is frequently added to flour of mustard, and when the quantity passes beyond a certain amount, it is undoubtedly an adulteration, for the intention of it should be only to reduce to an agreeable extent the pungency of the mustard.

(To be continued).

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 23, 1869.

R. ANGUS SMITH, Ph.D., F.R.S., Vice-President, in the Chair.

“*On Sulphurous Acid in the Air of Manchester*,” by PETER SPENCE, Esq., F.C.S.

Believing, as I do, that the evils of our town smoke are in a much larger degree due to the gases which result from our coal consumption than to the black smoke, which is the one thing generally complained of and legislated against—it occurred to me that one of these gases, which has a most pernicious influence upon vegetation, and which can hardly be favourable as a constant breathing medium to animal life, could be made visible in its effects to the eye. This is sulphurous acid gas, a very considerable product of the combustion of coal, containing 2 per cent sulphur on an average.

The experiments I have made have been repeated some fifteen to twenty times, and in two localities; the results are evident, and are now before the Society. I used litmus papers, exposing one series of slips in the middle of the lawn at my house, at Smedley, about two miles nearly due north from the centre of the town, so that any wind between west, south-west, and east-south-east covers us with the smoke of a large section of Manchester, and, as these winds blow four-fifths of the year, Smedley has the lion’s share of the town’s smoke.

The slips were changed at eight in the morning and at six in the evening, so that they represent alternately day and night, and I may say that the results almost completely ignore the effects of large chimneys, the night slips being as decidedly acted upon as the day’s, and none

of them more so than the night between Saturday and Sunday morning. The effects are in remarkable connection with the state of the wind or set of the atmosphere, so much so that if shown a slip exposed there for twelve hours I could almost tell from it in what direction the wind had been. During most of the days and nights of exposure the wind was south, coming over the broadest section of Manchester; on Sunday it changed to east, coming over Harphurhey and Mosten; although the apparent smokiness was not much less, the colouring was slighter.

Gilda Brook, near Eccles, where the other slips were exposed, is west of Manchester, and fully three miles from the centre of the town, and there, even with an east wind, the diffusion of the gas is seen in the more slight colouring.

I am still continuing the exposures, and shall, probably, in addition to this, attempt to measure the actual quantity of SO_2 on some day when Smedley has the benefit of the fullest sweep of the Manchester atmosphere.

As to the effects of these gases upon vegetable life, I have full proof at Smedley; vegetable life on the whole of that side of town is a mere struggle for existence.

As an instance, as I am leaving it for the opposite side, where only a due north wind, which almost never blows, will bring me the smoke, I have been able to try its effects upon about twenty plants of camelias: these I had at Smedley, most of them for eight years, and the blooms had dwindled down year by year till, in the spring of 1868, I had only three or four miserable specimens. Early last May I moved them to the south side of town; nothing else was done to them: they made their growth as usual, only more vigorously, and showed abundance of flower buds,—this they had frequently done at Smedley, but there they generally nearly all dropped off; this season they dropped none: they are now and have for the last three weeks been covered with beautiful blooms, and I have no hesitation in saying they have brought to maturity more in number than they did in all the eight years at Smedley.

The CHAIRMAN stated that he had made experiments many years ago on the air of Manchester, and had found a large quantity of sulphurous acid, which was frequently converted into sulphuric acid. There was also a large quantity of muriatic acid. These gases were brought down by every drop of rain, in sufficient quantity to redden litmus paper. He considered that smoke, as well as the gases, was very detrimental to both animal and vegetable life.

GLASGOW PHILOSOPHICAL SOCIETY.

CHEMICAL SECTION.

A meeting was held in the Hall, Andersonian University, on Monday, the 15th inst., at eight o'clock in the evening, Dr. Anderson, the President, in the Chair.

Two members were admitted by ballot.

W. H. PERKIN, Esq., F.R.S., read a paper entitled "*Observations on some Artificial Colouring Matters.*" We hope to be able to give a further notice of this paper in an early issue.

ROYAL GEOLOGICAL SOCIETY OF IRELAND.

THERE was a meeting of this Society on Wednesday evening, March 10th, Sir D. CORRIGAN, Bart., in the chair. This meeting was the first of a series of intended joint meetings of the Royal Geological and Zoological Societies, to be held in the Museum Buildings of Trinity College.

Mr. M. H. ORMSBY, LL.D., of the Geological Survey of India, read a communication, dated June 19th, 1868, from Mr. A. Dempster, describing the Prince of Wales gold mine at Sebastopol Ballarat. The paper was accompanied by specimens of the workings. The matrix yielded in washing 30 grains of gold for every 14 ounces.

NOTICES OF BOOKS.

"*Obituary Notices of Deceased Fellows.*" (*Proceedings of The Royal Society*, Nov. 30th, 1868).

"*Faraday as a Discoverer.*" By JOHN TYNDALL. Longmans, Green, and Co., 1868.

IN our impression of August 30th, 1867, we had the melancholy duty of announcing the death of our great countryman, Faraday. The short, and in many respects imperfect, sketch which we then placed before our readers was written hastily and under the influence of feelings which could not fail to suggest themselves at such a time.

Since then, affectionate friends, comrades, and fellow-labourers of the great philosopher* have, in the truest spirit of love and veneration, collected a mass of information regarding his life both as a man and an investigator, which we heartily commend to the perusal of our readers. At the time when we wrote our first notice of Faraday, it was difficult to obtain reliable information regarding his early life and studies. His temperament was so completely averse to every kind of self assertion or display, that it was necessary for him to die before all his greatness could be known. Fortunately for the world, two of Faraday's friends have had the means, the inclination, and the opportunity of giving us, not sketches, but finished pictures of his outer and inner life.

Even with the comparatively meagre information we possessed in August, 1867, we ventured to assert of Faraday that "he was the only man who has raised himself to the first rank in science in this country, whose every attribute we may fearlessly hold up as a model to our children!" If we wrote thus when we did, how much more shall we not repeat it with the light now before us? There can be no stronger proof of the goodness as well as greatness of Faraday than the deep affection with which he inspired his friends.

The obituary notice of Faraday in the *Proceedings of the Royal Society* is written by Dr. Bence Jones, and it is a model of what such notices should be. Instead of the feeble, rambling, and often half-hearted panegyrics we are so much accustomed to, we have a clear, well written, chronological history of his life, occupying sixty-eight closely-printed pages; but, owing to the perfect method and concise mode of expression, there is more matter in it than in two hundred pages written in the slipshod manner too commonly adopted by biographers. We shall make no apology for presenting our readers with an outline of Faraday's life, greatly condensed from Dr. Bence Jones's notice.

Æt. 1 to 12 (1791 to 1804).—Michael Faraday, the third son of James Faraday, was born at Newington, in Surrey, September 22nd, 1791. His father worked as a blacksmith at Boyd's, in Welbeck Street, and, after living for a short time in Gilbert Street, they removed, when Michael was about five years old, to rooms over a coach-house, in Jacob's Well Mews, Charles Street, Manchester Square. This was the home of Faraday for nearly ten years, in fact, until 1809, when they moved to 18, Weymouth Street.

When thirteen years old (1804) he went on trial for a year to Mr. George Riebau, a bookbinder.

Æt. 13 to 19 (1805 to 1811).—On the 7th of October, 1805, Faraday was apprenticed to Riebau, and in consequence of his faithful service his master dispensed with a premium. Here Faraday first saw Mrs. Marcet's "*Conversations on Chemistry*," and the treatises on electricity in the "*Encyclopædia Britannica*." These works appear to have had the effect of giving him his first draughts of scientific knowledge. As may be supposed, he at once commenced making such experiments as were possible with his limited means.

At this period he also attended lectures on natural philosophy, given by Mr. Tatum.

* "Faraday loved this word and employed it to the last; he had an intense dislike to the modern term *Physicist*."—TYNDALL.

Æt. 20 (1812).—Through the kindness of Mr. Dance, who was a customer of Riebau's, and a member of the Royal Institution, he was enabled to attend four of the last lectures of Sir H. Davy. At this period, "the desire to be engaged in scientific occupation, even though of the lowest kind, induced me, whilst an apprentice, to write, in my ignorance of the world and simplicity of my mind, to Sir Joseph Banks, then president of the Royal Society. Naturally enough, 'no answer,' was the reply left with the porter."

He now began to construct small galvanic batteries; and the tenor of his letters at this date shows that his mind was entirely bent on scientific pursuits.

On the 8th of October he went as journeyman bookbinder to a Mr. De la Roche, a French emigrant, in London. This man was of a violent temper, and caused Faraday much trouble.

Encouraged by Mr. Dance, he sent Sir Humphry Davy the notes he had taken of his last four lectures. The reply he received was immediate, kind, and favourable. Although still working as a bookbinder, he at this period acted for a few days as amanuensis to Sir Humphry Davy, who was suffering from a wound in the eye received during his examination of chloride of nitrogen.

Æt. 21 (1813).—One night, while living in Weymouth Street, he was startled by a loud knock at the door, and a footman, who had alighted from a carriage, left a note for him from Sir Humphry Davy. This letter was to offer him a situation as assistant in the laboratory of the Royal Institution.

He was soon at work on various investigations for Sir Humphry; amongst others, on chloride of nitrogen. He had four violent explosions while engaged in its examination. One of these occurred while holding a tube containing $7\frac{1}{2}$ grains of the chloride. His hand was blown open and a part of one nail torn off. Fortunately, he wore a glass mask, which saved his eyes. As it was, the mask was cut by the pieces of the tube.

Æt. 22 (1814).—He visited Rome with Sir Humphry.

Æt. 23 (1815).—Still in Rome. His life at this time was to some extent troubled by the fact that Sir Humphry imposed tasks upon him connected with domestic duties, which should never have been proposed to him. It would appear, however, that Sir Humphry was very careful not to give him work which he disliked, as soon as his objection to it was known to him. Lady Davy, on the other hand, gave him much annoyance from her domineering propensities. A fortnight after his return to England, his salary as assistant in the laboratory was raised to 30s. a week, and rooms were given him.

Æt. 24 (1816).—He now gave lectures on chemistry, at the City Philosophical Society, and published his first paper, "An Analysis of Native Caustic Lime," in the *Quarterly Journal of Science*.

Æt. 25 (1817).—He published a paper "On the Escape of Gases through Capillary Tubes." He was also hard at work at his education.

Æt. 26 (1818).—Gave five lectures at the City Philosophical Society, and published six papers in the *Quarterly Journal*, the most important being "On Sounds produced by Flame in Tubes."

Æt. 27 (1819).—This appears to have been a comparatively uneventful year with Faraday.

Æt. 28 (1820).—First paper read before the Royal Society. It was "On Two New Compounds of Chlorine and Carbon, and on a New Compound of Iodine, Carbon, and Hydrogen." Experiments in conjunction with Stodart, on the alloys of steel.

Æt. 29 (1821).—His marriage, and admission into the Sandemanian Church. Paper in conjunction with Phillips "On a New Compound of Chlorine and Carbon." Succeeds in causing the wire to move round the magnetic pole and the pole round the wire.

Æt. 30 (1822).—Comparatively uneventful.

Æt. 31 (1823).—Papers in *Transactions of the Royal Society*, "On Fluid Chlorine," and "On the Condensation

of several Gases into Liquids." Four papers in the *Quarterly Journal of Science*. Proposed as Fellow of the Royal Society. Elected Corresponding Member of the Academy of Sciences, Paris.

Æt. 32 (1824).—Elected Fellow of Royal Society, and of Geological Society.

Æt. 33 (1825).—Made Director of the Laboratory of the Royal Institution. Discovered benzol.

Æt. 34 (1826).—Paper "On Action of Sulphuric Acid on Naphthalin;" "On the Existence of a Limit to Vaporisation;" "On Pure Caoutchouc, &c."

Æt. 35 (1827).—Commenced researches on optical glass. Published his "Chemical Manipulation."

Æt. 39 (1831).—Published the first series of "Experimental Researches in Electricity."

Æt. 40 (1832).—Second series of "Experimental Researches in Electricity."

Æt. 41 (1833).—Third, fourth, fifth, and sixth series of "Experimental Researches." Elected Fullerian Professor of Chemistry.

Æt. 42 (1834).—Seventh, eighth, and ninth series of "Experimental Researches."

Æt. 43 (1835).—Tenth series of "Experimental Researches." Granted pension by Lord Melbourne. Awarded one of the royal medals by the Royal Society.

Æt. 44 (1836).—Appointed adviser to the Trinity House. Made senator of the University of London.

Æt. 45 (1837).—Eleventh series of "Experimental Researches."

Æt. 48 (1840). Sixteenth series of "Experimental Researches." Appointed elder in the Sandemanian Church.

Æt. 51 (1843).—Eighteenth series of "Researches."

Æt. 52 (1844).—Paper communicated to Royal Society, "On the Liquefaction and Solidification of Bodies generally existing as Gases."

Æt. 53 (1845).—"Researches on Magnetisation of Light and the Illumination of Magnetic Lines of Force."

Æt. 56 (1848).—Twenty-second series of "Researches."

Æt. 58 (1850).—Twenty-third to twenty-seventh series of "Researches."

Æt. 61 (1853).—Sent to *Athenæum* his "Experimental Investigation of Table Turning."

Æt. 63 (1855).—Made Commander of the Legion of Honour.

Æt. 64 (1856).—Last paper sent to Royal Society: "Experimental Relations of Gold (and other metals) to Light."

Æt. 66 (1858).—Offered a house at Hampton Court by the Queen. Researches on Regelation, printed in Tyndall's paper "On Ice of Irregular Fusibility."

From this period, the record of his life ceases to be marked by events connected with his researches. He continued to give vast numbers of reports to the Trinity House, and at times gave lectures. But his health was rapidly declining, and his memory not to be relied on.

It need not be said that, in the declining years of his life he was tended with unfailing devotion and care, not only by affectionate relatives, but by friends whose veneration and love were as great as it was possible for those of relatives to be. Tyndall gives the following touching account of the last time Faraday spoke to him (p. 168):—

"Sometimes, during the last year of his life, by the permission or invitation of Mrs. Faraday, I went up to his rooms to see him. The deep radiance, which in his time of strength flashed with such extraordinary power from his countenance, had subsided to a calm and kindly light, by which my latest memory of him is warmed and illuminated. I knelt one day beside him on the carpet, and placed my hand upon his knee; he stroked it affectionately, smiled, and murmured in a low soft voice the last words I remember as having been spoken to me by Michael Faraday."

It is charming to find throughout Tyndall's entire work such a deep reliance on the goodness and kindness of Faraday. He is not, however, a mere blind adorer; he analyses with wonderful skill Faraday's mental process, and wherever he feels it his duty to differ with him he

does it faithfully, but with the gentleness and tenderness of a loving son.

Every one who has read attentively Faraday's paper "On the Magnetisation of Light and the Illumination of the Magnetic Lines of Force," must have been surprised at its title: the writer well remembers how intensely *he* was puzzled by it. Dr. Tyndall says on this subject, "In November, 1845, he announced his discovery of the 'Magnetisation of Light and the Illumination of the Lines of Magnetic Force.' This title provoked comment at the time, and caused misapprehension. He therefore added an explanatory note; but the note left his meaning as entangled as before; in fact, Faraday had notions regarding the magnetisation of light which were peculiar to himself, and untranslatable into the scientific language of the time. Probably no other philosopher of his day would have employed the phrases just quoted as appropriate to the discovery announced in 1845. But Faraday was more than a philosopher; he was a prophet; and often wrought by an inspiration to be understood by sympathy alone." Then, after a lucid explanation of the experiment itself, Tyndall goes on to say, "His magnet turned the plane of polarisation of the beam through a certain angle, and thus enabled it to get through the analyser, so that 'the magnetisation of light and the illumination of the magnetic lines of force' becomes, when expressed in the language of modern theory, *the rotation of the plane of polarisation*."

We need not say that, if Dr. Tyndall was happy in the friendship of Faraday, Faraday was to be congratulated that his mantle, (which Tyndall modestly says is almost too heavy to be borne), has fallen upon such shoulders.

Dr. Tyndall's work is illustrated by two exquisite portraits of Faraday. The frontispiece is engraved from a negative taken some years ago specially for Dr. Tyndall. The portrait facing p. 79 is a gem in its way. It is from a daguerreotype by Claudet, taken when Faraday was about fifty years old. We consider, however, that the engraving we present to our readers this week, is a still more striking likeness of the great philosopher. It is printed from a block in the possession of the Editor, and is probably not to be surpassed in vigour and truthfulness.

In conclusion, we earnestly recommend Dr. Tyndall's work, not merely as a charming biographical sketch, but as a masterly analysis of the mind of one of the greatest and best men the world has ever produced.

CORRESPONDENCE.

THE NEW EARTH IN SOME ZIRCONS.

To the Editor of the Chemical News.

SIR,—The history of the discovery of absorption bands in certain zircons is so thoroughly given in the CHEMICAL NEWS for the 12th inst., that I am reluctant to trouble you with any further communication on the subject. Yet I cannot refrain from commenting on three or four remarks in Mr. Sorby's valuable letter therein given.

1. Mr. Sorby says that I observed (1866) the spectrum of the new element in a "very imperfect manner." But the new spectrum which was then described was soon found to be more complex; while a rough pen and ink sketch in a letter was not likely to represent it faithfully. But how does my drawing really differ from Mr. Sorby's? The chief differences arise, not from the imperfection of my observation, but from the intense absorptive power of the specimen of jargon from which I drew the figure. This caused at once a broadening of the bands, and in some cases, a coalescence of two bands into one. But after all it will not be surprising if the greater skill and better instruments of Mr. Sorby have enabled him to make a more accurate drawing.

2. My remark as to the Ceylon and Norway zircons showing the bands referred, of course, only to those few transparent specimens which I then possessed. I have since met with many stones from both localities which showed either no bands or mere traces of bands.

3. Mr. Sorby says I was led to conclude that the production of the bands might depend on the presence of Svanberg's norium. I "hazarded the conjecture," but all I concluded was, that the presence of these bands in the spectra of some zircons and their absence from others showed that the bands must be due to some substance other than zirconia.

4. In conclusion, I may say that my studies and analyses of several well-marked black-band zircons have convinced me that the new earth will not be found "to constitute the chief ingredient of some of the jargons from Ceylon:" I very much wish that this was likely to be the case.

I reserve a fuller account of my results till they have been rendered more complete by further research. I propose to continue to devote my attention to the chemical and analytical side of the inquiry; the physical study of the zircon could not have fallen into more appropriate or abler hands than Mr. Sorby's.—I am, &c.,

A. H. CHURCH.

Royal Agricultural College, Cirencester,
March 15, 1869.

BIPHOSPHATED PERUVIAN GUANO.

To the Editor of the Chemical News.

SIR.—In spite of Mr. B. H. Paul's attempted explanation of his first letter, and his assertion that the analyses of our manure justify the use of the expressions contained in that letter, we still think his attack unwarrantable.

We decline further correspondence with Mr. Paul, but as we are bringing our action against him with as little delay as possible, he will have another opportunity of explaining his views on the subject.—We are &c.,

REES AND CO.

32, King William Street, London,
March 16, 1869.

MISCELLANEOUS.

The Gas Inspectorship for the City.—Mr. Charles Heisch, F.C.S., was on Thursday last elected to the office of Gas-Examiner to the City of London. This gentleman is known from his connection with the firm of Murray and Heath.

New Pocket Spectroscope.—Mr. W. Ladd, of Beak Street, Regent Street, has invented a small pocket spectroscope, which is, without exception, the most powerful for the size we have ever seen. It consists of a lens, a system of direct vision prisms and a slit. The system of prisms, containing 3 flint and 2 crown, is about $\frac{3}{4}$ of an inch long, and the whole only occupies a tube about $\frac{1}{2}$ an inch wide and $1\frac{3}{4}$ inches long. It shows the Fraunhofer lines very distinctly, and by holding a jargon in front of the slit we have been able to detect the absorption bands of jargonium. Great credit is due to Mr. Ladd for this ingenious, useful, and very convenient form of spectroscope.

Royal Institution.—The following are the probable arrangements for the Friday evening meetings after Easter:—

April 9.—W. B. Carpenter, M.D., V.P.R.S., &c.; "On the Temperature and Animal Life of the Deep Sea."

April 16.—W. Carruthers, Esq., F.L.S., of the British Museum; "On the Cryptogamic Forests of the Coal Period."

April 23.—E. B. Tylor, Esq.; "On the Survival of Savage Thought in Modern Civilisation."

April 30.—Robert H. Scott, Esq., of the Meteor-

logical Office; "On the Work of the Meteorological Office, Past and Present."

May 7.—Capt. Moncrieff; "On the Moncrieff System of Working Artillery."

May 14.—W. H. Perkin, Esq., F.R.S.; "On the Newest Artificial Colouring Matters."

May 21.—Professor H. C. Fleeming Jenkin, F.R.S.; "On the Submersion and Recovery of Submarine Cables in deep water."

May 28.—J. Norman Lockyer, Esq., F.R.A.S., M.R.I.; "On Recent Discoveries in Solar Physics made by the Spectroscope."

June 4.—Professor Odling, F.R.S."

NOTES AND QUERIES.

Carbolic Paper.—Pagliari, an Italian chemist, has invented a kind of paper wherein carbolic acid is so thoroughly incorporated that the paper, when used to pack animal substances therein, preserves the same in a fresh state without salt or any curing whatever.

Odylic Force.—In the obituary notice of Baron von Reichenbach, in No. 480, vol. xix., of the CHEMICAL NEWS, it is stated he has investigated the supposed new *odylic force*. Can any of your subscribers give a list of his writings on this subject, or those of any other author who has written on the same subject in French, German, or English?

On some New Products Obtained from American Petroleum.—Lefebvre has found therein a substance which boils at 23°C ., and the composition of which is expressed by C_6H_8 ; the specific gravity of this liquid is 0.613, the vapour density is 1.60; with hydrochloric acid it forms propyl-chlorhydric ether. The residue of the rectification of these kinds of petroleum yielded hydride of butyl, C_8H_{10} , which boils at 0°C ., and has a specific gravity of 0.624.

Vanilline.—Mr. Gobley has instituted researches concerning the odoriferous principle of vanilla. He found a substance therein which crystallises in long colourless needles; to the taste this substance was aromatic and hot; it does not affect litmus paper, fuses at 70°C ., volatilises at 150°C ., is nearly insoluble in cold, somewhat more soluble in hot water, and very soluble in alcohol, ether, and volatile as well as fatty oils. Its composition is expressed by $\text{C}_{20}\text{H}_{16}\text{O}_4$. Gobley calls it *vanilline*.

Action of Heat on Tartaric Acid.—Dr. Sace has heated tartaric acid in a large glass retort, taking care that not a particle of the acid was carried over mechanically during the process of distillation. He obtained in the receiver a very acid, nearly colourless, very mobile liquid, which turned out to be acetic acid; there was left in the retort a carbonaceous mass, while carbonic acid was given off. According to the author, it is possible that tartaric acid is a double acid made up of oxalic and acetic acids.

Hydroxyl.—Would you be good enough to inform me what is the nature and properties of "hydroxyl"? This substance is one with which candidates in the coming examination of the Department of Science and Art are expected to be acquainted with. I for one never heard of it before, and a search I have made to find it even mentioned in either Watts's "Dictionary" or in Miller's and Roscoe's books has been unsuccessful.

[Hydroxyl is another name for peroxide of hydrogen. It is supposed to act as a compound radical, equivalent to the simple radical chlorine. —Ed. C. N.]

Drying Green Wood.—A new method for drying green wood in a short time consists in boiling it for some hours in water, then leaving it to cool, next boiling it in an aqueous solution of borax, whereby the insoluble albumen of the wood is rendered soluble and escapes from its pores. The wood is then dried in chambers heated by steam, and left therein for three days. Wood so treated is more compact than it would be by ten years' exposure to air; it is far more secure against decay, does not shrink nor warp, and is more easily polished, on account of its having obtained by this treatment a more dense structure.—*Builder*.

On the Soluble Hydrates of Carbon met with in Fruits.—Commaile asserts that the saccharine materials met with ready formed in fruits, and also the substances which are capable of becoming saccharine matter, are far more varied than is usually supposed; in melons and parsnips Commaile, while testing the juice of these fruits at divers periods of maturity and development, found sometimes saccharine substances capable of left-handed polarisation, sometimes substances endowed with right-handed polarisation, sometimes he found levuline, and at other times substances as yet either entirely unknown or imperfectly described; he comes to the conclusion that the various substances met with in fruits are always in a state of change.

Positive or Negative?—Will one of your numerous readers be so kind as to inform me which is the *positive* and which the *negative* end of a voltaic battery? Miller, in vol. i., p. 577, says the zincode is the same as the anode, or positive pole, and that here we have O, Cl, and acids, which therefore must be electro-negatives. The platinode is said to be the same as the cathode or negative pole, and that here we get H, metals and the alkalis (electro-positives). In Lardner's "Handbook of Electricity," edited by Foster, p. 104, the zinc end is marked negative, and the copper positive. Ganot, in his "Physique," 7th edition, 1857, p. 596, says "Le pole positif est toujours à l'extrémité vers laquelle les zinc de chaque couple sont tournés; et le pole

negatif à l'extrémité vers laquelle sont tournés tous les cuivres." All this is sufficiently puzzling, but on referring to an old edition of Golding Bird (1854), p. 341, he says that both O and H, together with N, S, P, Cl, &c., are electro-negative elements. If O is given out at one end, and H at the other, how can they both be electro-negative? Again, he says (p. 344), "the positive current passes from the copper to the zinc plate." Other writers say exactly the reverse. If any one would put this matter in a clear light, the medical students of this country ought to vote him (I don't say they will) a piece of plate (not electro).—A MEDICAL STUDENT.

On Some of the Changes Pitcoal Undergoes when Heated.—Dr. E. Richter records some curious phenomena concerning coal when submitted for some time to heat. He took coal, reduced it to powder, and dried it in the cold over sulphuric acid until it ceased to lose weight; the coal was then heated to a temperature of from 180° to 200°C .; after having been submitted to this heat, even for a short time, an increase of weight was found to have taken place; this increase in weight was observed to go on until, after twenty hours, it reached its maximum, since, if the heating were continued after that time, a decrease of weight was observed. The coal, the weight of which had increased, was found to differ from the coal originally taken in the following particulars:—Its outward physical appearance is not perceptibly altered, but it has increased in specific gravity, its chemical composition is changed, it behaves in a peculiar manner when coked in a covered crucible, and it has obtained increased faculty of attracting water from the air. Even when the coal originally taken and dried under a desiccator belonged to the caking coals, after heating it does not cake any longer, but behaves as a non-caking coal when ignited in a close crucible. When submitted to destructive distillation, the first products which come over into the receiver shows, in a very remarkable degree, a reddening of blue litmus paper, while no tar is produced at all. When 2 grammes of the previously heated (to 180° or 200°) coal were left exposed on a watch glass, even to a rather dry atmosphere, it was found that, after fourteen and thirty-six hours' exposure, the increase in weight was respectively 3.3 per cent and 4.8 per cent, when exposed in a drying stove to a temperature of 105°C . for a quarter of an hour, the original weight was restored again. As regards the chemical composition, it was observed that the previously heated coal differed from that dried under the desiccator by a loss of carbon and hydrogen and an increase of oxygen and nitrogen.—*Abridged from the Deutsche Industrie Zeitung*.

MEETINGS FOR THE WEEK.

MONDAY, March 22nd.—Medical, 8.
Royal Geographical, $8\frac{1}{2}$.
London Institution, 6.
WEDNESDAY, 24th.—Geological, 8.
THURSDAY, 25th.—London Institution, 6.

TO CORRESPONDENTS.

*** With this number is given a separate sheet containing a portrait of the late Professor Faraday and a *fac simile* autograph.

G. H. Ogston.—Messrs. Rees and Co.'s letter renders yours unnecessary. The correspondence on the subject of Biphosphated Peruvian Guano had better cease now.

Subscriber.—The fullest details are given in Fresenius's "Quantitative Analysis."

H. Smith.—Hofmann's Exhibition Report is not to be had. You might see a copy in some library.

E. Baguley.—We regret that we are unable to supply the information.

York.—No trustworthy details have been published.

S. C. C.—You will find the papers referred to in one of our recent volumes.

Communications have been received from H. C. Sorby, F.R.S.; Professor Church, M.A.; E. P. H. Vaughan; Professor Gustavus Hinrichs (with enclosure); Townsend and Adams; S. C. C.; P. S. B.; J. Spiller; T. Hill; M. A. Baines; S. E. Philips; York; Chromo; W. H. Walenn; W. Mattieu Williams; J. Pattinson; H. Smith; H. C. South; Edwin Smith, M.A.; G. Baguley; E. V. Blackwell; G. H. Ogston; Muspratt Bros. and Huntley; Rees and Co.; Herrings and Co.; Dr. Aloin Pflughaupt; A. Casartelli; R. J. Reynolds; P. Curie; J. Wilkinson and Co.; F. E. S. Jerningham; A. Gibbs; T. Felton; D. Evans (with enclosure); Groombridge and Sons; S. M. Harrison; F. S. Sillitoe; J. Walch; A. N. Palmer; R. Schenk; T. Watts; W. Mackenzie; Mawson and Swan; R. Lavender (with enclosure); C. Cochran (with enclosure); P. Holland; C. M. King (with enclosure); Sir Charles Wheatstone, F.R.S. (with enclosure); The Astronomer-Royal; Miss Bunvill; The Radcliffe Observatory; and J. W. Slater (with enclosure).

BOOKS RECEIVED.

The Medical and Surgical Reporter, vol. xx., Nos. 1 to 7. Philadelphia and New York.
Breathing considered in relation to the Bodily, Mental, and Social Life of Man. By Thomas Robinson. Glasgow: John Thomson.
Notes on the Alcohols from Coal Tar, and on Rhubarb. By E. R. Squibb, M.D. Philadelphia: Merrihew and Son.
Facts and Fallacies Discussed in a Series of Letters Written with reference to a Constant Service and a Future Source of Supply of Water. By John Taylor, C.E. London: E. and F. N. Spon.

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Hydrostatics,	Heat,	Electro-Magnetism,
Hydraulics,	Light,	Magneto-Electricity,
Pneumatics,	Magnetism,	Thermo-Electricity,

This Catalogue includes the Apparatus that was recommended for use in Elementary Schools, in the Report addressed to the Committee of Privy Council, By the Rev. Dr. TEMPLE, formerly Her Majesty's Inspector of Schools, and now Head Master of Rugby School.

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Vol. III., on Food, Sugar, &c., is at present out of print.

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Deputy-Chairmen { WILLIAM BOWMAN, Esq., F.R.S.
SIR CHARLES LOCOCK, Bart., D.C.L., F.R.S.

Extracts from the Report of the Directors, presented at the Annual General Meeting held on the 27th November, 1868:—

1. The sum of £412,345 was proposed for Assurance, of which £307,395 was completed, at Premiums producing £10,067 per Annum.
2. The amount paid under Claims by death was £100,883, being the smallest since 1860, whilst the expenses of management and all other outgoings were even less than for many years past.
3. On the other hand, the Income was raised to £219,769, notwithstanding that its increase was retarded by abatements of premium which did not take effect in the previous year, and by the cessation of interest on the large sum paid as Bonus in 1867.
4. The Surplus income was very considerable. It amounted to £93,152, a sum exceeding by more than £8,000 any previous Surplus during the forty-four years of the Society's existence.
5. The Accumulated Fund was thereby increased to £1,598,906.

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Mr. J. C. BRAITHWAITE, for thirteen years Principal Instructor in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c., wishes to inform his old Pupils and others that he continues to devote his whole attention to Education.

The Session 1868—1869 will commence on the 1st of October, when Mr. BRAITHWAITE'S Laboratory, which has been enlarged, will be re-opened at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

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The LATIN CLASS for the reading of the Pharmacopœia, Physicians' Prescriptions, &c., every Tuesday and Friday Evening, at 8 p.m., commencing October 2nd.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday Evening, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday until further notice.

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The Royal Polytechnic.—Last Lectures on ASTRONOMY, by Professor Pepper, Monday, Wednesday, and Thursday, at 3 and 7.30. Subject:—"The Sun, and Discoveries of Norman Lockyer, Esq." Mr. J. Browning's Observations of an enormous Train of Sun Spots, also of the remarkable Lunar Craters of Aristarchus and Linné. All the Entertainments and Lectures as usual. NB.—Great preparations are being made for the Easter Holidays.

THE CHEMICAL NEWS.

VOL. XIX. No. 486.

ON THE CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(ADAPTED TO A JUVENILE AUDITORY),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN,

(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, Esq., M.B., F.R.S.

(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE VI.

(Concluded from p. 136).

CARBONIC DISULPHIDE—CARBON—CARBONOUS OXIDE—
CARBONIC GAS.

AND now we pass on to the consideration of an entirely different section of our subject. You will remember that ordinary charcoal is obtained from wood. When wood is strongly heated or burnt in a limited supply of air, the carbon of the wood scarcely burns at all, and we have this carbon preserved to us in the form of charcoal. Charcoal, then, is the chief constituent of wood, in which substance it exists in the unburnt condition; and not only does charcoal exist in wood, but in nearly all vegetable substances. The seeds of wheat contain starch, in which charcoal exists; sugar, too, contains a considerable proportion of charcoal, and when these substances are burnt they leave a great deal of charcoal behind. Here, for instance, we have some wood shavings. Now I can very readily show you the charcoal in these wood shavings by pouring upon them a little of that very corrosive substance called oil of vitriol. By letting this liquid act upon the shavings for a little time they quickly change into a mass of black charcoal. In the case of such a substance as sugar, the action takes place still more rapidly. Here in this large cylinder are some pieces of sugar; I moisten them with a little hot water, and then pour some oil of vitriol upon them, and you observe that when I do so the sugar is at once converted into a mass of black charcoal. [The sugar became rapidly charred by the sulphuric acid, and the admixture emitted steam, and swelled into a black spongy mass, overflowing the glass jar in which the experiment was

performed, and which, in the first instance, was not more than one-third full.]

All these substances which I have mentioned to you as containing carbon, burn very readily into burnt carbon or carbonic gas. If, for instance, I burn a piece of wood in a small tube of oxygen, you will find that a brilliant flame is produced, and the result will be the formation of carbonic gas, which is proved by the application of the lime-water test.

Instead of burning the charcoal directly in oxygen gas, as I have done in two or three previous experiments, I am now going to burn it in a substance which contains oxygen gas; and it shall be burnt under water and the carbonic gas which is produced collected in a cylinder. [A mixture of nitre and carbonaceous matter was burnt in a tube under water.] You see that, in this way, our cylinder which was full of water is now becoming full of burnt charcoal or carbonic gas. I cause some of the gas to bubble up through lime-water, and you see the lime-water becomes converted into a mixture of chalk and water, proving that we really have produced gas of this kind. I will now collect some of the gas in a separate vessel, and again show you its nature by its property of extinguishing flame.

Now, if you reflect a little, I think you will come to this conclusion,—that substances which grow, vegetable substances, are all of them destined ultimately to become burnt, or to undergo a change equivalent to burning. A great deal of wood, for instance, is chopped up and used for fire wood; a great deal more is used for building ships, for forming the interior portions of houses, and making furniture. These ships and houses and furniture last for a certain time; they gradually pass from an honourable into a dishonourable condition; old furniture is put into the lumber room; the disabled ships are broken up and destroyed, and at last they go to the fire, where the carbon becomes oxidised or converted into carbonic gas. But there is a great deal of vegetable matter which never undergoes this burning. In the autumn a large quantity of leaves fall to the earth and there undergo some sort of change; this change is, in fact, a very slow burning, but without the phenomena of ignition which we see in the case of a fire, although the leaves are converted into carbonic gas or oxidised carbon. Now here is a bottle which contains some decaying wood, and, as I showed you in the last lecture, a lighted taper introduced into the bottle is at once extinguished by the burnt carbon or carbonic gas, which has been produced by the oxidation of the wood in the process of decay. Here, again, is some rotting sawdust; this also gives rise to carbonic gas, which extinguishes a lighted taper introduced into it. You see, therefore, that although the wood does not actually undergo

* Reported verbatim, by permission of the Author, for this Journal.

the process of burning, as we are accustomed to see it, it does undergo the process of decay, which is a conversion of the original carbon into burnt charcoal. But a great quantity of vegetable substance neither undergoes burning nor decaying, but is eaten. We know that cattle feed largely on corn and straw, and we ourselves consume much wheat and other grain. In these instances, although the vegetable substances do not, strictly speaking, *decay*, yet they undergo another form of the process of oxidation, by which burnt charcoal is produced. For example, if we take a little lime-water, and blow, or rather breathe, through it, we have evidence of a considerable amount of burnt carbon being present in the breath. In this case, the carbon, instead of having been burnt in a furnace, has simply been burnt in our bodies, thereby rendering our bodies warm, just as when it is burnt in the fire it warms a room. In order to show you the presence of carbonic gas in the breath, it will be quite sufficient for me to breathe into a bottle of lime-water. Here is one—I breathe into it, close it, and shake it up, and by that simple act I have, as you see, produced a very considerable quantity of chalk, showing the presence of carbonic gas, or burnt carbon.

All vegetable tissue, then, comes sooner or later to be burnt, or oxidised, or converted into carbonic gas.

The next point which I should like you to notice is the *unburning* of carbonic gas. How is it possible to do this? On this subject I must just call your attention to what is here written upon the diagram:—

Carbon }
2 Oxygen } Carbonic gas.

Carbon }
1 Oxygen } Carbonous oxide.

Carbonic gas is really a combination of one proportion of carbon and two proportions of oxygen. Now there is another oxide of carbon of which I have not yet spoken, which consists of one proportion of carbon and one of oxygen; it is called carbonous oxide. If I take carbonic gas and half unburn it, I remove one-half of the oxygen, and the result is carbonous oxide. How is this done? Well, one way is by burning something in carbonic gas. If you take one of the few substances that will burn or oxidise in carbonic gas, you will find that that substance by its burning will take away some of the oxygen from the carbonic gas, and thereby convert it into carbonous oxide. One of the commonest forms of this experiment is to take some carbonic gas and pass it through a tube filled with red-hot iron. Under these circumstances, the iron takes away some of the oxygen, or unburns the carbonic gas down

to carbonous oxide; but I am about to show you a more convenient form of the experiment, and one for which I am indebted to Dr. Taylor.

I take, not metallic iron, but metallic magnesium, and I will show you that, although a taper is extinguished in the carbonic gas, yet the magnesium will burn. I introduce a piece of ignited magnesium, and it continues to burn in the carbonic gas. You see that a taper, when introduced into the same gas, is extinguished, whilst the light of the magnesium, under the same circumstances, is so brilliant that it almost blinds one for the moment. Now when this metal—magnesium—burns in this way it reduces, or decomposes, or unburns, the carbonic gas to the state of carbonous oxide; but there are some metals, you will remember, which go beyond that. When a piece of sodium is burnt in carbonic gas, it not only unburns the carbonic gas to the state of carbonous oxide, but it takes away all the oxygen and reduces the carbonic gas again to a piece of charcoal. By means of the magnesium, we unburn the gas by taking away one proportion of oxygen, and reducing it to a compound which contains one proportion of oxygen and one of carbon; but when sodium is used, the two proportions of oxygen are taken away and the carbon left free.

Here is a vessel generating carbonic gas in the usual way. The gas is being conducted into this glass globe, and it is there made extremely hot by the action of the electric spark. An intense degree of heat is produced, and, under these circumstances, the carbonic gas breaks up into a mixture of carbonous oxide and oxygen. Now for this purpose we do not necessarily require the heat of the electric spark. Even the heat that we can obtain by the combustion of a flame of ordinary gas in a current of oxygen is quite sufficient for our purpose. I have here a supply of coal gas; I pass oxygen into its flame, and with this flame I will heat a platinum coil. I now allow the carbonic gas to pass through the heated platinum coil, and in its passage the carbonic gas is decomposed into carbonous oxide and oxygen. To give you some idea of the amount of heat which can be produced in this way, I will hold in front of the blowpipe flame a plate of iron. You see that, although this plate is one of considerable thickness, it is utterly unable to withstand the high degree of heat which I am in this way applying to it. [Holes were burned in the plate of iron at those points on which the flame was allowed to impinge.]

When our carbonic gas is subjected to this extreme degree of heat, it undergoes decomposition—not into carbon and oxygen, but simply into carbonous oxide and oxygen. It only becomes one-half unburnt. Now are there any agencies in nature by which this carbonic gas can be com-

pletely unburnt? There is one, and one only, that is, through the influence of vegetation under exposure to the sun's rays. If, in the spring time, when the sun is shining, we take some rapidly growing plant—for instance, a sprig of mint, which answers the purpose very well—and immerse it in a vessel of water which is charged with carbonic gas, that carbonic gas will undergo an unburning; its oxygen will gradually bubble up from the leaves of the plant, and rise to the top of the vessel of water; but what will become of the carbon? It will be converted into starch and wood and sugar and other substances, which go to form the living plant. By this means only can the carbonic gas be unburnt into carbon, which goes into the tissues of the plants, and into oxygen, which is given off again into the atmosphere.

Now what is the point of interest in an unburning of this kind? If I were to allow an electric spark to pass through the air it would give out a certain amount of heat, but, on passing through the carbonic gas, it emits a considerably less amount. Well, what has become of the difference? It has gone somewhere. If I take this mixture of carbonous oxide and oxygen, produced from the carbonic gas by the passage of the electric spark, and set fire to it, it gives out exactly the amount of heat that disappeared from the heat of the spark. In that case, the carbonous oxide and the carbon burn together. I will give you an illustration of the combustion of these two substances. Here is a large cylinder of the half unburned carbonic acid; I set fire to it, and you see the curious blue flame which it emits and the peculiar manner in which it burns. I have also some of the carbonous oxide burning from a tube, and if I hold over its flame an empty bottle, I shall be able to collect the burnt carbonic gas which is so produced. You see the beautiful blue flame which the carbonous oxide sends out from the tube. I may also show you the considerable amount of heat which it gives out in burning. If I introduce into the flame a piece of platinum wire you see it immediately becomes very red, showing the flame to be exceedingly hot. Now when I burn together the carbonous oxide and the oxygen, which have been separated from one another, exactly the same amount of heat is given out by it that was absorbed from the electric spark by the products of the unburning of the carbonic gas, and was not used in heating the surrounding air.

Now, if the sun, instead of shining on the plants which grow on the earth's surface, were to shine entirely upon the stones, it would heat the atmosphere a great deal more than it does. As it is, a portion of the sun's heat disappears. What, then, becomes of it? It is absorbed by the vegetation. The amount of heat absorbed

by a growing piece of wood in unburning the carbonic gas of the atmosphere into charcoal and oxygen, is exactly the amount which the piece of wood is capable of giving out when its carbon is re-burned in the air; and, accordingly, when we burn coals, or wood, or peat upon our fires, or consume bread, and oil, and wine in our bodies, and thereby produce a considerable amount of heat either in the fires or in our bodies, we are really manifesting once more, in the form of heat, the sun's rays, which years and years before shone upon the plants from which those substances were derived. We are getting back the sun's heat, which was originally absorbed by the growing plants. When we burn any one of these substances we recover from them the sun's heat which disappeared in their growth. We will here burn some sugar, and we shall be able to regain very easily an exhibition of the sun's rays that were absorbed in separating the carbon of the sugar from the oxygen with which it was in combination, and which, upon being separated, was discharged into the air. I pour a drop of this liquid upon the mixture of sugar, and you see the very brilliant evolution of the sun's rays which were bottled up in the formation of the sugar.

And now it only devolves upon me to thank you heartily for your kind attention during these lectures. I hope, that whenever again you see a piece of coke, or a piece of charcoal, or a piece of marble, or a growing plant, you will remember the curious relations of change which exist between them, and how the one is capable of being converted into the other.

ON THE
IMMEDIATE ANALYSIS OF DIFFERENT
VARIETIES OF CARBON.

By M. BERTHELOT.

(Continued from page 137).

II. INFLUENCE OF SUNDRY AGENTS UPON CARBON ALREADY FORMED, AS HEAT, CHLORINE, IODINE, OXYGEN, AND ELECTRICITY.

1st. I did not succeed in passing from one group to the other under the influence of heat alone—that is, by calcining graphites and amorphous carbons at a white heat in an atmosphere of hydrogen. The amorphous carbon only appeared to augment in cohesion, whilst pyro-graphitic oxide, after calcination, does not yield more graphitic oxide than before.

2nd. Chlorine, at a white heat, does not change either wood charcoal into graphite or graphite into amorphous carbon; free carbon is well known to be unaffected by it. Iodine, at a white heat, does not change coke into graphite, it does, however, produce this transformation in nascent carbon at a red heat.

3rd. The action of oxygen causes simultaneously an extreme elevation of temperature, and the formation of carbonic acid and oxide of carbon. Carbon submitted to this double influence may be examined by lighting, at a

jet of oxygen, a pencil of retort charcoal, previously heated to redness. Whilst the point is in full incandescence, it must be quickly plunged into cold water to extinguish it; the extreme end of the pencil is then detached, taking only that part which has been most thoroughly heated. The carbon thus treated does not consist entirely of amorphous carbon, but also contains a small quantity of graphite, formed under the double influence of heat and oxidation. The same influences prevail in the case of incomplete combustion, when lampblack is formed; in this I have observed the presence of a trace of graphite; the occurrence of a similar trace of graphite in certain cokes is attributable, in my opinion, to the same cause.

These different results merit the more attention as it is possible that analogous phenomena may have played some part in the natural formation of graphite. To a similar origin has been attributed until now the formation of graphite and anthracite; but the result of my observations is, that the spontaneous decomposition of organic remains, even with the assistance of red heat, would furnish no plumbagine. The origin of the latter requires special explanation.

I have also examined the poles of carbon employed for the transmission of electric light. The powdered carbon, obtained by scraping a number of charcoal pencils which had formed the negative poles in producing electric light, was subjected to oxidation, and large quantities of graphitic oxide were thus obtained. This latter, and consequently electric graphite also, are identical with neither those of cast-iron nor of plumbagine.

The change which is here produced in the amorphous charcoal of gas retorts may also be seen in diamond. M. Jacquelin has demonstrated that diamond placed in the voltaic arc changes into a sort of coke. I was enabled to examine the same specimens which had been used in former experiments at the Sorbonne: the carbonaceous matter which had undergone oxidation was changed into graphitic oxide of the same kind as that of the charcoal from the retorts.

It was, therefore, probable that charcoal which had undergone the action of the voltaic arc would contain no diamond; this I carefully ascertained to be a fact, operating on considerable quantities of matter. None of the specimens (obtained from the experiments made by Despretz upon sugar charcoal, with a pile of 600 elements) contained the least trace of diamond.

The formation of electric graphite does not occur indifferently at either of the electric poles. The negative poles only thickened by the passage of the carbon, furnish a large quantity of graphitic oxide, whilst the corresponding positive poles, thinned by the same phenomenon, contain only traces, which are probably due merely to the necessarily imperfect separation of carbon during the act of electric illumination. Transformation into graphite does not, however, require the previous volatilisation of the carbon; finally, capsules of sugar charcoal, softened by the heat of a pile of 600 elements, were found to be for the most part changed into graphite at the negative pole.—*Comptes Rendus*.

ON THE SUBSTITUTION OF SODIUM FOR PHOSPHORUS IN LUCIFER MATCHES.

Dr. H. FLECK, of Dresden, has instituted a series of experiments with the view to obtain a non-poisonous paste for the application to lucifer matches. He ascertained, by some preliminary experiments, that sodium, when minutely divided along with explosive substances, becomes highly inflammable when simply moistened with water. A mixture, constituted according to the formula—

$(\text{KO}, \text{NO}_5) + \text{Na} + 2\text{C} = (\text{KO}, \text{CO}_2 + \text{NaO}, \text{CO}_2) + \text{N}$,
formed a greyish-coloured mass, which, on being touched with a moistened glass rod, ignited like gunpowder; this

mixture was, however, found to be unfit to ignite ordinary brimstone matches for a cotton wick soaked in petroleum. In order to mend this defect, black sulphuret of antimony was substituted for the charcoal, according to the formula $3(\text{KO}, \text{NO}_5) + \text{Na} + (\text{SbS}_3) = (\text{NaO}, \text{SbO}_5) + 3(\text{KO}, \text{SO}_3) + 3\text{N}$, and the mixture made up of—

0.5 grammes of sodium	= 4.65 per cent
66.0 ,, nitrate of potash	= 61.39 ,,
36.5 ,, sulphide of antimony	= 33.96 ,,

Provided that during its manufacture this mixture is kept thoroughly dry, it has been found to answer admirably well. The mode of making it up is briefly as follows:—Pure solid paraffin is put into a well-stoppered glass flask, and melted over a sand bath, when fluid, clean pieces of sodium are added, and liquefied under the paraffin. As soon as the metal is thoroughly liquefied, the flask is closed and shaken for about ten minutes, which has the effect of granulating the metal, or rather reducing it to a fine powder. The metal is then poured out of the flask along with the paraffin, and the sodium taken out of the paraffin by means of a clean dry spoon; from 30 to 35 per cent of paraffin remains adhering to the metal; this, however, does not impair its inflammability, while it tends to preserve the metal. Owing to this increase, instead of 5 grammes, 6.6 grammes of the metallic powder thus obtained must be weighed off. The incorporation with the other ingredients, previously well dried and warm, is effected under petroleum in metallic mortars, but each of the substances is first mixed with some petroleum, and pulverised separately before being triturated with the sodium; instead of gum or glue, caoutchouc, previously soaked in light petroleum oil at 110° C. for ten or twelve hours, is used as mass to form an adhesive paste with the other materials. According to several accounts from Germany, this plan of substituting sodium for phosphorus has been favourably taken up by some of the largest and leading manufacturers of lucifer and fusee matches. There is said to be not the least danger in the transport.—*Abridged from Deutsche Industrie Zeitung*.

ON THE PRESERVATION OF TIMBER.*

By P. M. MOIR.

THE preservation of timber is of great practical importance—its preservation is alike valuable to the student, the practical worker, and the capitalist; and it is not to be wondered at that many minds have been directed to solve the question whereby decay may be arrested, and the timber preserved and made as durable as the other parts of the construction it may be in union with.

A very common and destructive kind of decay is dry rot, which is often very rapid in wasting the substances of timber, more particularly in such places as are free from a circulation of air.

There is another familiar agent deadly to timber, which we in this country are not acquainted with, but which is the cause of great destruction in India, Ceylon, Brazil, and all tropical countries, where it is very abundant. I refer to the white ant, or termite. Its attacks are most ravenous on all wood buildings, railway sleepers, and bridges, although the material used in the latter be of *lignum vitæ*, a very hard and durable wood.

Timber used for marine purposes is subject to the attacks of the *Teredo navalis* and *Limnoria terebrans*. Greenheart timber, in its natural state, is the only wood now in use for harbour works that is free from the attacks of marine worms and insects, and the white ant in tropical countries.

There are two reasons why this timber resists the ravages of these insects—1st, its hardness; 2nd, it contains a large quantity of essential oil.

* Abstract of a paper read before the Glasgow Philosophical Society (Chemical Section), Feb. 1, 1869.

I now come to the various methods that have been adapted and tried for the preserving of timber, both from natural decay and destruction, mentioned—and these have been mechanical and chemical.

The mechanical have been wholly applied for marine purposes, and are the oldest in use. The first, I may mention, consisted in covering piles, between high and low-water mark, with flat-headed iron nails, the heads being about 1 inch in diameter, driven into the wood as close to one another as they could be put without overlapping; the water soon acted upon them by corrosion, which penetrated the skin of any portion of the wood not covered by the nails. This process is very expensive, not only in the materials used, but the amount of labour required driving in the nails.

Another plan was to cover the piles with sheets of zinc or copper.

I next come to the chemical processes that have been tried, and are still in use, for preserving wood.

Upwards of fifty patents have been taken out for preserving animal and vegetable substances, including timber, many of which have never been worked practically; in fact, there are only six that I am acquainted with that have been worked commercially—Kyan, 1832; Margary, 1837; Bethell, 1838-48; Burnett, 1838-40; Payne, 1841-46; Boucherie, 1839.

These patents were obtained for the application, either by steeping or filling the pores of timber by pressure in close vessels with solutions of different chemical agents; excepting Boucherie's, and he latterly adopted the salt used by M. Margary—viz., the sulphate of copper.

PATENTS.

Kyan ..	1832	Chloride of mercury.
Margary ..	1837	Sulphate of copper.
Bethell ..	{ 1838 1848 }	Creosote, or pitch oil.
Burnett ..	{ 1838 1840 }	Chloride of zinc.
Boucherie ..	{ 1839 1846 }	Pyrolignite of iron. Sulphate of copper.
Payne ..	{ 1841 1846 }	Sulphate of iron. Carbonate of soda.

In the working of these patents practically, there were three different methods used in the application—viz., steeping, vital suction, and pressing in close vessels. The first of these was adapted by Kyan and Margary, the second by Boucherie, and the third by Payne, Burnett, and Bethell, and latterly by Boucherie. In the first and third methods, the several processes required the timber should be seasoned and free from sap.

Kyan's process was the mixing of chloride of mercury, in proportion of 1 lb. of salt to 5 gallons of water.

Margary, in 1837, obtained a patent for preserving timber, ropes, canvas, cloth, &c., by soaking them in a solution of sulphate of copper.

Payne, in 1841, obtained patent rights for a process for preserving timber. His plan was the production of a double decomposition in the pores of the wood, by first injecting a solution of some metallic body, such as sulphate of iron, which was forced into the wood under pressure in iron cylinders; after the wood had absorbed the quantity required, the surplus liquor was drawn off, and a solution of carbonate of soda forced in, which fixed the iron in the cellular tissues of the timber, forming oxide of iron.

Sir William Burnett took out a patent in 1838 and in 1852; the latter was an extension of his patent rights for seven years. His patent was for the preservation of timber, canvas, cordage, cotton and woollen cloths, &c., with a solution of chloride of zinc ($ZnCl$), the proportion used being 1 gallon of the concentrated solution to 40 gallons of water.

I have now to bring before your notice the last of these patents—viz., Bethell's process for preserving timber with creosote, or pitch oil. This invention differs entirely from

all the others, in so far that the oil used is not only a most powerful coagulator of albumen, but it likewise preserves the fibre of timber. Of all processes for preserving timber, this one seems to have found most favour, as it has been universally used, not only in Great Britain and Ireland, North and South America, India, and all continental countries in Europe, wherever railways have been constructed, but also in harbour works, for which it is especially applicable in resisting the attacks of marine worms and insects. Many patents have been obtained for the use of oleaginous substances in preserving timber, but none were brought into practical use until Bethell procured his in 1838. In some instances cylinders are open at both ends, and closed with iron doors, so that sleepers or timber entered at one end, on being treated, can be delivered finished at the opposite end. I have found, however, for all practical purposes that one open end is sufficient, as the oil when heated, being of such a searching character, it is a difficult matter to get the doors perfectly air-tight, consequently they are apt to leak during the time the pressure is being applied. Pipes are led from the cylinder to the air and force pumps; the air is not only extracted from the interior of the cylinder, but also from the pores of the timber. When a vacuum is made, the oil, which is contained in a tank below the cylinder, is allowed to rush in, and as soon as the cylinder is full, the inlet pipe is shut and the pressure pumps started, to force the oil into the wood; the pressure maintained is from 150 to 200 lbs. to the square inch, until the wood has absorbed the required quantity of oil, which is learned by an index gauge fixed to the working tank below. All cylinders are fitted with safety valves, which allow the oil not immediately absorbed to pass again into the tank. The oil is heated by coils of pipe placed in the tank, through which a current of steam is passed, from end to end, raising the temperature to $120^{\circ} F$. The quantity of oil recommended by the patentee, engineers, and others, is 8 lbs. of oil for land purposes, and 10 to 12 lbs. to the cubic foot for marine. In this country, for marine the quantity does not exceed 12 lbs.; but on the continent—in France, Belgium, and Holland—the quantity used is from 16 to 26 lbs. per cubic foot. Beech has absorbed as high as 31 lbs. of oil per cubic foot, and when used for planking, either for railway platforms or harbour works, is, without doubt, the cheapest and most durable material that can be used.

I estimate the possible yield of pitch oil in Scotland at 1,000,000 gallons; this is mostly all used for creosoting purposes; latterly a portion has been applied for fuel burning under steam boilers. It is slightly soluble in water, consequently it could not be used for out-door purposes in its pure state; it requires to be mixed with oils, or the other portions of the creosote, which fill up the pores of the timber, which, on exposure to the air, solidifies, giving the wood a coating, and making it impervious to water and the action of the atmosphere.

In the new edition of Dr. Ure's "Arts and Manufactures," under the head of "Wood Preserving," it is stated that Bethell's process "produces perfect coagulation of albumen in the sap, thus preventing its putrefaction."

In a letter written by Dr. Letheby, extracted from the *Journal of the Society of Arts*, after describing the action that takes place when timber is prepared with creosote, he concludes his letter by stating that the preservative action is of four kinds:—

1st. It coagulates albuminous substances, and gives stability to the constituents of the cambium and cellulose of the young wood.

2nd. It absorbs and appropriates the oxygen which is within the pores of the wood, and so checks, or rather prevents, the eremacausis of the ligneous tissue.

3rd. It resinifies within the pores of the wood, and in this way shuts out both air and moisture.

4th. It acts as a positive poison to the lower forms of

animal and vegetable life, and so protects the wood from the attacks of fungi, acari, and other parasites.

The creosoting process since it was first introduced in 1838, has been extensively employed in Great Britain and Ireland, and in all countries on the continent of Europe where creosote oil can be economically procured; wherever it has been properly carried out, it has been completely successful.

Of late, many railway companies have discontinued the creosoting of their sleepers, not on account of any failure in the process itself, but from the wear and tear of the chair cutting down into them, and gradually rendering them useless. This would not have been the case, to a great extent, had the base of the chair been broader, which would have prevented the mechanical action of sinking into the wood, and enabled the sleeper to have lasted much longer.

In India, and elsewhere abroad, where damp, dry rot, and insects destroy unprepared sleepers so rapidly, I say by all means creosote; and for all soft wood timber used in the construction of piers, bridges, and similar works, I say the same. Creosoting being a preservative against the attacks of the white ants in India, great numbers of creosoted fir sleepers were sent out from England. These creosoted sleepers were found to be very durable. The fir wood itself is perishable in India, probably from the heat causing the turpentine, &c., to evaporate rapidly, but the creosote has the effect of preserving it, and of preventing the depredations of all kinds of insects, even when the wood is most exposed to their attacks.

In the report presented by the Minister of Public Works in Belgium, in May, 1863, to the Legislative Assembly, respecting the operations of the State Railways in the year 1862, at page 12 it is stated as follows:—

“In 1862 a special commission was instituted to determine the state of preservation of the sleepers, which, before being put into use, have been the object of preparations destined to prolong their duration. The result of this commission has been to persuade the Government to give up entirely the process Boucherie, and for the future to abide by the using—1st, of oak sleepers in their natural state, or which have been submitted to the preparation of the creosote oils by system Bethell; 2nd, of beech sleepers or red pine, prepared after the same process.”

At page 86, a statistical table is published showing the numbers used between the years 1835 and 1863, in which table is stated that the average duration of unprepared oak sleepers is 11 $\frac{7}{11}$ years, and of unprepared fir sleepers, 7 $\frac{7}{8}$ years.

In the spring of 1865, a very careful examination was made by the authorities of all the creosoted sleepers, and they found that all these sleepers (although some of them had been in use 19 years) were perfectly sound and fresh, and, in consequence, the Belgian Government decided to have all their sleepers creosoted in future.

The annual Government report on the Belgian State Railways, for the year 1864, states:—

“123,397 sleepers, prepared by Mr. Bethell's process, were laid down; and 16,205 prepared by Boucherie's process (sulphate of copper); and 1,869 sleepers prepared by various other processes, were taken up.

“The administration, looking to the results of past years' experience, continues to confine itself to oak sleepers and creosoted sleepers for making or relaying its lines, as the superiority of Bethell's system over all others appears to be an established fact. Out of the 153,753 new sleepers put down in 1864, 128,165 were creosoted, and only 25,588 were unprepared oak.”

For marine purposes it is the only process now acknowledged by engineers to be applicable for preserving timber from the attacks of the *Teredo* and *Limnoria*. For harbour works in Scotland this process has been largely used. At Leith, the west pier is entirely constructed of creosoted timber, consisting of 1013 main piles; the extension of

the east pier also consists of 312 main piles creosoted. These erections were commenced in 1848, and finished in 1853, and at the present time they are all as perfectly sound as the first day they were put down. The gates of the new dock, now being constructed at that port are of creosoted pine bound with greenheart. The quantity of oil used was 10 lbs. per cubic foot. At Glasgow, all the wood-wharves, with exception of the steam-boat quay, are constructed of creosoted pine, 8 lbs. of oil being injected to the cubic foot. The whole of the wharves at Kingston dock, are entirely of creosoted wood, the same quantity of oil being used. At Port Glasgow and Greenock, timber prepared by this process is largely used, and at nearly every port in England.

Of late, several other processes have been patented for preserving timber.

Robbins's is to put the timber into iron chambers, and passing the vapours obtained from the distillation of coal tar into the chambers, and allow the timber to absorb the same without pressure.

The Resin Process.—The timber is first boiled in a weak solution of carbonate of soda, and then treated with liquid resin in close tanks heated to 306°.

Beerziny's is another process, and, as described by the patentee, he removes the sap of timber by boiling in water to which borax is added.

ON FOOD.*

By DR. LETHEBY, M.A., M.B., &c.

(Concluded from p. 139.)

Unwholesome and Adulterated Food.

OF the second class of adulterations, where the object is to improve the appearance of the article, there are many examples, as:—

(a). The addition of alum to bread, by which, as I have already explained, inferior, and even damaged, flour may be made into a tolerable looking loaf. It is the property of alum to make the gluten tough, and to prevent its discolouration by heat, as well as to check the action of the yeast or ferment upon it. When, therefore, it is added to good flour, it enables it to hold more water, and so to yield a larger number of loaves; while the addition of it to bad flour prevents the softening and disintegrating effect of the yeast on the poor and inferior gluten, and so enables it to bear the action of heat in the process of baking. According to the quality of the flour will be the proportion of alum, and hence the amount will range from 2 oz. to 8 oz. per sack of flour. These proportions will yield from 9 to 37 grains of alum in the quartern loaf, quantities which are easily detected by chemical means. Indeed, there is a simple test by which much smaller quantities of it may be readily discovered. Infusion of logwood, as you here perceive, acquires a rich purplish carmine, or claret tint, when it is brought into contact with alum; you have, therefore, only to dip a slice of the bread for an instant, as I am now doing, into a weak, watery solution of logwood, and if alum be present the bread will speedily acquire a purple or reddish purple tint. I have already described to you the other properties of good bread, as that it should not exhibit any black specks upon the upper crust; it should not become sodden and wet at the lower part by standing; it should not become mouldy by keeping in a moderately dry place; it should be sweet and agreeable to both taste and smell; it should not give, when steeped in water, a ropy acid liquor; and a slice of it taken from the centre of the loaf should not lose more than 45 per cent by drying.

Sulphate of copper is found to act like alum in improving the appearance of bread; and, according to Kuhlmann, Chevallier, and others, it is commonly used by

* The Cantor Lectures, delivered before the Society of Arts.

the bakers of the Continent, notwithstanding the severe penalties attached to it. In this country, however, it is but rarely employed.

(b). The bloom, or glaze, or facing of green and black tea is generally artificial. In the case of green tea, it is ordinarily a mixture of Prussian blue, turmeric, and sulphate of lime, or China clay; and in that of black tea it is not unfrequently a coating of black-lead. The tea prepared for the English market is notoriously subject to these adulterations; and it seems that it arises entirely from our own fancy, and not from any desire on the part of the Chinese to pursue such a practice. The adulteration is easily discovered by shaking the tea with cold water, and then straining through muslin, and allowing the fine powder to subside.

(c). Pickles and preserved fruits are often made green with a salt of copper, it being the peculiar property of that metal to mordant, or fix in an insoluble form, the green colouring matter or chlorophyl of vegetables. If, therefore, the pickling operation is conducted in copper vessels, or if a little verdigris or sulphate of copper is added to the vinegar in which the vegetables are boiled, the colour of them will be retained. In some cases the quantity added has been so large as to give a coppery look to a steel fork or knife plunged into the pickle. In such cases, as might be expected, severe symptoms of poisoning have been occasioned by it.

(d). Ferruginous earth, or red oxide of iron, is frequently added to sauces, to anchovies, to cocoa preparations, and to preserved or potted meats, to improve their appearance.

(e). Mineral pigments, often of a poisonous nature, are used in colouring confectionery.

And lastly, with the view of giving a false strength to the article, we have instances of sulphuric acid added to vinegar, black-jack or burnt sugar to coffee and chicory, catechu or *terra japonica* to tea, *coccus indicus* to beer, cayenne to peppers, &c.

That many of these sophistications are dangerous there can be no doubt, and all of them are frauds on the public. Parliament has therefore attempted to deal with the matter by legislation, as in the "Act for Preventing the Adulteration of Articles of Food or Drink" (23rd and 24th Vict., cap. 84) of 1860; but as the act is only permissive, little or no effect has been given to it. Even in those places, as in the City of London, where it has been put into operation, and public analysts have been appointed, no good has resulted from it; in fact, it stands upon the statute-book as a dead letter. Speaking for the City, I may say that every inducement has been offered for the effective working of the act, but nothing has come of it. In olden time the remedies for such misdemeanours were quick and effectual. In the *Assisa panis*, for example, as set forth in *Liber Albus*, there are not only the strictest regulations concerning the manner in which the business of the baker is to be conducted, but there are also the penalties for failing in the same. "If any default," it says, "shall be found in the bread of a baker in the City, the first time let him be drawn upon a hurdle from the Guildhall to his own house through the great streets where there be most people assembled, and through the great streets which are most dirty, with the faulty loaf hanging from his neck; if a second time he shall be found committing the same offence, let him be drawn from the Guildhall through the great street of Cheepe, in manner aforesaid, to the pillory, and let him be put upon the pillory, and remain there at least one hour in the day; and the third time that such default shall be found, he shall be drawn, and the oven shall be pulled down, and the baker made to forswear the trade within the City for ever." It further tells us that William de Stratford suffered this punishment for selling bread of short weight, and John de Strode for making bread of filth and cobwebs. One hoary-headed offender was excused the hurdle on account of his age and the severity of the season; and it would seem that the last time the punishment was inflicted

was in the sixteenth year of the reign of Henry VI., when Simon Frensshe was so drawn. A like punishment was awarded to butchers and vintners for fraudulent dealings; for we are told that a butcher was paraded through the streets with his face to the horse's tail, for selling measly bacon at market, and that the next day he was set in the pillory with two great pieces of his measly bacon over his head, and a writing which set forth his crimes. In the judgments recorded in *Liber Albus* there are twenty-three cases in which the pillory or the thew was awarded for selling putrid meat, fish, or poultry; thirteen for unlawful dealings of bakers, and six for the misdemeanours of vintners and wine-drawers. Of a verity we have degenerated in these matters.

And now, in conclusion, having directed your attention to the nutritive values of different kinds of food; to their functional and dietetical powers; to the modes in which they are associated; to the quantities required for ordinary labour; to the manner in which they are digested; to the effects of culinary and other treatment; to the way in which they may be preserved; and to the causes of their unwholesomeness, we may finally ask if any great generalisations can be deduced from our inquiries?

In the first place, you will, I think, have observed that there are very striking evidences of design in the way in which organic matter is constantly kept in motion, for, whether living or dead, it is always in a state of molecular activity—either advancing towards the highest state of organisation, or retreating to the confines of the mineral kingdom. The result of this is that, with a comparatively small amount of material, and with but little expenditure of force, the work of the living world is fully and effectively performed. Starting from the mineral kingdom, as carbonic acid, water, and ammonia, the elements of organic nature pass through a succession of changes, first in the vegetable and next in the animal, until they reach the summit of organisation, when they again return to their primitive condition. In this manner a never-ending round of change is perpetuated, and the same material and the same force are kept moving in the same continuous circle. Through the efforts of the plant the crude materials are formed into vegetable acids, sugar, gum, starch, fat, albumen, and tissue; and then the animal converts them into higher forms of structure, as gelatine, muscle, and brain; the two extremes, therefore, of these changes are, to use the words of Gerhardt, carbonic acid, water, and ammonia at one end; albumen, gelatine, fat, and cerebral matter at the other—but the transitions to these extremes are countless, and are as yet beyond the reach of science. Broadly, however, we may say that the chemical functions of the plant are those of reduction or deoxidation, whereby carbonic acid and water are deprived of their oxygen and moulded with nitrogen into food; while those of animals are of an opposite nature, for they destroy this food by oxidation. The plant, therefore, is the machine or medium whereby carbonic acid, water, and ammonia are converted into new compounds, and light and heat are transformed into chemical affinity; and the animal is the medium or machine whereby these compounds are destroyed, and their affinities changed into other manifestations of force, and finally into heat. In this way, the circuit of change is completed; and it is not difficult to trace the phenomena of vitality to the cosmical forces which the plant had imprisoned. But shall we ever be able to follow, through all the intricacies of change, the countless transitions of both matter and force in their passage from the mineral kingdom to the animal, and then back to the mineral again? It is easy to connect, by a correlation of force, the muscular movements of the animal body, and even the highest efforts of the human mind, with the sunbeam which the plant had arrested; but shall we ever be permitted to unravel those mysterious functions, those intermediate changes which constitute the phenomena of life? Why is it, for example, and how comes it, that the living

cell of the plant is able to aggregate mineral matter in opposition to the common laws of affinity, and can transform light and heat into cell-force? How is it, too, that the animal, in reversing the process, and so restoring the play of affinity, is able to transmute it into other manifestations of force? At present, the utmost we can say of it is, that organic matter is the appointed medium of all these changes, and is designed for the exhibition of vital phenomena, just as mineral matter is the appointed medium for the phenomena of electricity and magnetism; and yet to some extent, perhaps, we are able to penetrate the mystery; for, by finding the clue to the peculiar action of the vegetable in reducing chemical compounds, we can, by operating on such substances as carbonic acid, water, and ammonia produce a large number of organic principles; in fact, of the three great classes of alimentary substances, to which I have so frequently directed your attention—namely, the oleaginous, the saccharine, and the albuminous—it may be said that the first is already within the manufacturing power of the chemist, and the second is nearly within it; so that there is abundant proof that the agency of a vital force is not necessary to the formation of organic compounds; and there is even hope that the fabrication of food may not be altogether beyond the capabilities of man.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 18th, 1869.

Dr. WARREN DE LA RUE, F.R.S., President, in the Chair.

PREVIOUS to the reading of papers, the President announced from the chair that it had been proposed to substitute the name of Dr. J. L. W. Thudicum for that of Mr. E. T. Chapman in the balloting papers for the Council. The proposal would be suspended in the Society's rooms, along with the printed list, according to the by-law.

Dr. GUTHRIE wished to know if he could make a resolution before the papers were read; but it was decided that it had better be left till the anniversary meeting.

A paper by Mr. ARTHUR ELLIOTT, "*On the Determination of Carbon in Cast-Iron*," was read by Mr. Vacher, who remarked that the great advantage of the process was that it had succeeded well in not very experienced hands, where other processes had failed. The author's method is adapted principally from Ullgren (*Anal. d. Chem. u. Pharm.*, 124, 59), and consists in treating from 2 to 2.5 grammes of pulverised iron borings, rejecting any large pieces, with 50 c.c. of solution of sulphate of copper (1 in 5), heating gently for ten minutes, when the iron dissolves and metallic copper separates, the carbon remaining undissolved. 20 c.c. of solution of chloride of copper (1 in 2) and 50 c.c. of HCl are then added, and the mixture heated nearly to the boiling point, until the separated copper dissolves. The carbon is collected on a filter made of combustion tube, 15 c.m. long, one end being drawn out to a point 4 m.m. wide, and stopped first with broken glass, and then loosely with ignited asbestos, and washed with boiling water till free from chlorides. It is then converted into carbonic acid, and the latter determined, by transferring the carbon in the tube to a flask, adding 3 grammes of chromic acid, the flask is then supplied with a funnel tube and attached to a bottle one-third full of sulphuric acid, and this is connected with a U-tube, filled with pumice-stone saturated with sulphuric acid. This tube is connected with two smaller U-tubes, for absorbing the carbonic gas—one containing soda-lime, and the other pumice and sulphuric

acid. 30 c.c. of sulphuric acid are gradually added to the flask, which is shaken, and the contents boiled for one minute; the tap of the funnel tube is opened, and a tube containing soda-lime connected; an aspirator is then applied to the small U-tube containing pumice and sulphuric acid, and air drawn at the rate of two or three bubbles per second.

The PRESIDENT thought that in rejecting any part of a given sample which would not pulverise, there was a danger of rejecting a portion of iron having a different proportion of the metal to the carbon, as compared with the rest of the sample. Mr. Forbes, who had given attention to the subject, would perhaps favour them with some remarks.

Mr. FORBES did not like to offer any opinion on the process till he had tested it himself. He had tried every process that had been made known, and was not at all satisfied of their great accuracy. He, and many others, would be very glad to submit the present process to enquiry, to determine its accuracy.

The next paper was a rather long one, by Mr. E. T. CHAPMAN and Mr. MILES H. SMITH, which was followed by a discussion. Owing to pressure of matter, we are compelled to postpone our report of it till next week.

Dr. ODLING then read a paper, by Professor G. G. Stokes, F.R.S., "*On a Certain Reaction of Quinine*." The author stated that some time had elapsed since he had made these investigations, but not being a chemist, he had not ventured to lay the results before the chemical world; he had recently, however, been encouraged by a chemical friend to think that a fuller statement might prove of some interest to chemists. The reaction is best observed by diffused daylight entering a darkened room through a hole in the shutter of about 4 or 5 inches square, or a packing case may be made to answer very well. The hole is covered with glass coloured a deep violet by manganese. In front of it is placed a white porcelain tablet; a solution of quinine in very weak alcohol, or very small fragments may be used. In some cases, alcohol interferes with the reaction. The phenomena exhibited by sulphuric and hydrochloric acids were as follows:—When a drop of the quinine solution was touched by a rod dipped in dilute sulphuric acid, the fluorescence of the quinine was instantly developed. With hydrochloric acid, no apparent effect was produced, but hydrochloric acid destroyed the effect of sulphuric acid; and if a little sulphuric acid were added to the drop containing only hydrochloric acid, no effect was manifest. The author found that, on trying a variety of acids, they ranged definitely into two classes, A and B—class A developing fluorescence like sulphuric acid, and class B destroying it, like hydrochloric acid. The alkaline salts of the acids were found to destroy the fluorescence, as well as the free acids themselves. The following are the acids operated on by the author:—Class A. Acetic, arsenic, benzoic, chloric, citric, formic, hyposulphuric, iodic, malic, nitric, oxalic, perchloric, phosphoric, silico-fluoric, succinic, sulphuric, tartaric, and valerianic. Class B comprises hydriodic, hydro-bromic, hydrochloric, hydroferrocyanic, hydro-palladiocyanic, hydroplatinocyanic, hydrosulphocyanic, and hyposulphurous. The character of the fluorescence of the salts of quinine in the solid state varies; the solid iodate obtained by precipitation is strongly fluorescent, with a blue considerably deeper than that of the solutions. The absorption of the fluorogenic rays by the yellow ferrocyanide of potassium would, in itself, account for the apparent destruction of the fluorescence, if the salt were present in sufficient quantity; but, to destroy the fluorescence, a less quantity is sufficient than would be required to prevent its exhibition by the absorption either of the fluorogenic or of the fluorescent rays, or of both; the author therefore concludes that the removal of the fluorescence is a true chemical reaction, and not a mere optical effect. The classification made by the quinine reaction agrees almost exactly with the old distinction of ox-acids and hydracids. The author had found, however,

that hyposulphurous acid, which is not usually ranked with the hydracids, ranged itself in class B, and led him to seek for other analogies between hyposulphurous and the hydracids; and he found that hyposulphite of soda restored the blue colour to litmus which had been reddened with chloride of mercury; he also found that, in common with the hydracids, it very readily decomposed cyanide of mercury. Fluorescence had been restored without precipitation, in the case of hydrochloric acid, by the sulphate or nitrate of the red oxide of mercury, and that the restoration of fluorescence was not a mere effect of the acid with the mercuric salt could be proved by adding just enough hydrochloric acid to destroy fluorescence in quinine dissolved in nitric or sulphuric acids; on stirring a little precipitated oxide of mercury in the mixture, the fluorescence returned. The fluorescence, destroyed by a chloride, was in some measure restored by nitrate of cadmium. The precipitate obtained with bromide of potassium was white, and showed a pretty orange fluorescence—a very unusual colour for the fluorescence of a white substance.

The PRESIDENT spoke of the importance of Professor Stokes's interesting paper; it was very possible that considerable light would be thrown on the nature of different chemical compounds by such facts as he had brought forward. Although spectroscopic analysis was more general in its application to rays of all refrangibilities, it would be of some value in dealing with the fluorescent rays, which are rays of one, or very few different, refrangibilities.

Dr. ODLING said that if he had not occupied too much time, he would like to make a remark on the composition of hyposulphurous acid, as to whether it was a hydracid or an ox-acid. Hyposulphite of soda was generally written by the formula $\text{Na}_2\text{S}_2\text{O}_3$, together with an atom of water, and the atom of water was essential to all the hyposulphites. If, instead of writing the formula in this manner, it was written $\text{Na}_2\text{H}_2\text{S}_2\text{O}_4$, it might represent the single or the double molecule of hyposulphite of soda. Assuming it represented the double, the formula for the simple hyposulphite would be NaHSO_2 , and that salt would correspond to an acid H_2SO_2 , of which the next term would be H_2SO_3 , and the next H_2SO_4 . If this was the correct formula for hyposulphurous acid, it might evidently be regarded as a hydracid. Dr. Dupré had read a paper which contained this suggestion. He (Dr. Odling) thought that when Dr. Dupré brought forward this formula, he viewed it as the analogue of formic acid, and as, in that acid, one of the atoms was replaced to form formate of soda, so, in hyposulphurous acid, only one atom was replaced to form hyposulphite of soda; but if this were correct, it did not follow that this acid was the analogue of formic acid as regards its internal molecular arrangement. There was no doubt of formic acid being an ox-acid; but hyposulphurous, even with this formula, might be a hydracid. HCl represented hydrochloric acid, and HOCl , hypochlorous acid, so that the hydrogen was united to the chlorine by the oxygen, and it is a true ox-acid. The fact that NO_2 was capable, in a great number of cases, of taking the place of Cl made it an open question whether it was not a hydracid, notwithstanding its containing oxygen, on the assumption that hydrogen was not directly united with oxygen, as in the case of hypochlorous and cyanic acids. Nitric acid, HO, NO_2 , in which (assuming, from the nature of the body) the hydrogen is directly associated with the oxygen, is a true ox-acid, and starting from this point, we have hyposulphurous acid, which would be a true hydracid; sulphurous acid, which would be an intermediate acid; and sulphuric acid, which would be an ox-acid. The hyposulphites certainly corresponded with the halogen salts in their remarkable tendency to form double salts, the *raison d'être* of which was not satisfactorily established. The constitution of the double chlorides of mercury and sodium, and of mercury and ammonium, had not been accounted for on the ordinarily-received views of atomicity, unless Mr. Wanklyn's view

was followed, and a higher atomicity given to them than was generally accorded. He (Dr. Odling) objected to elaborated formulæ, for those chemists who wrote the formula of hyposulphurous with the two sulphurs written in different ways, and the oxygen in different ways, assumed that they knew all about it; but he thought there was a great deal to be learned, and the best way was to express it ordinarily, in the most compressed form, and then, as an illustration, put forward some further elaborated scheme, which might, and very likely might not, be true.

The PRESIDENT announced that the next meeting of the Society would be the Anniversary Meeting, on March 30th, at 8 o'clock; and he asked as many gentlemen as possible to attend, as the officers would be elected and he would have to resign the Presidentship.

CORRESPONDENCE.

THE CHEMISTRY OF SUGAR REFINING: BEANES'S PROCESS FOR PURIFYING BONE-BLACK.

To the Editor of the Chemical News.

SIR,—Will you kindly afford me space to explain the cause of the apparent inconsistency between the views expressed by Dr. Wallace on the above subject and those which Mr. P. Casamajor has embodied in the letter which you published last week?

The fact announced by Dr. Wallace, that "acids invert cane sugar," has been known to me for the last thirty years, and is, I believe, familiar to most persons engaged in the sugar manufacture. So well, indeed, is it understood in America and on the continent of Europe, that every precaution is taken to neutralise the acidity of the crude sugar before submitting it to the action of the animal charcoal. This practice does not prevail in England; sugar refiners here trust to the calcic carbonate present as an impurity in the charcoal for the neutralisation of the acid of the sugar; and, as my process removes this calcic carbonate, it renders the charcoal less suitable for the rude and unscientific method in vogue here, than it is for the greatly superior method adopted in countries where the manufacture is better understood.

The decolourising effect of bone-black upon syrup is in proportion to the extent of *carbon surface* exposed. The smaller the grains the greater is the decolourising effect produced; and yet our sugar refiners load with calcic carbonate—*white-wash*, as it were,—the very carbon surface upon which they depend for the decolourisation of their syrups! The practice seems to me, I confess, irrational in the highest degree.

Old bone-black, freed from lime and other impurities, is inferior in power to new because its carbon surface is less. Its innumerable little prominences have been removed by friction, it has become polished, and the extent of surface which it exposes is thereby reduced, but it is nevertheless, as might have been expected, very much more efficient than a similar black from which the calcic carbonate has not been removed.—I am, &c.,

E. BEANES.

Cordwalles, Maidenhead, Berks,
March 15th, 1869.

THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—As the writer of the letter which was read from the chair at the last meeting of the Chemical Society, proposing that the name of Mr. Ernest Theophron Chapman should be replaced by that of Dr. J. L. W. Thudicum as one of the new members of Council, I shall be glad if

you will kindly afford me the opportunity of giving the reasons which induced me to take so decided a step.

Of Dr. Thudicum, I may remark that he is a gentleman holding a high official position; his advice and assistance on scientific and chemical subjects are frequently sought by different departments of Government; and his researches in spectrum analysis, and elaborate investigations on chemical pathology in connection with the cholera are of very high scientific value, besides being of almost national importance. Besides this, the gentleman I have the honour to nominate has the advantage of five years seniority in our society over Mr. Chapman. Of the latter gentleman, I do not wish to say anything that can detract from his known ability, but think that the interests of the Society would not suffer from his absence from the governing body—at least until his judgment is a little more matured.—I am, &c.,

JOHN SPILLER.

[We feel it our duty to allow Mr. Spiller the opportunity of stating the reasons which induced him to write the letter which was read from the chair at the last meeting of the society. According to the fifth by-law, our correspondent's proposal, after having been read from the chair, is to be publicly suspended in the society's rooms with the list recommended by the council. The balloting papers, which have now been sent to all members of the society, contain a notice which is intended to meet such a case as this. They state "If you wish to substitute any other name in place of that proposed, erase the printed name in the second column and write opposite to it in the third that which you wish to substitute.—*Ed. C. N.*]

MISCELLANEOUS.

The Presidency of the Chemical Society.—Dr. Frankland having been nominated by the Council to the Presidency of the Society for the ensuing year, and he having felt himself obliged to decline the office,—at a subsequent meeting of Council Dr. Williamson was nominated instead, and new balloting lists were ordered to be circulated among the Fellows.

Discovery of Platinum in Scotland.—According to a brief account in the *Mining Journal*, an explorer announces that, during his investigation into the auriferous nature of Scotch quartz, he has discovered small quantities of platinum associated with the gold there existing. The platinum exists in the form of small scales resembling silver, but they are not magnetic like much of the crude platinum found in South America. In the process employed the gold was volatilised by chlorine at a bright red heat, but the platinum was left unacted on by the chlorine. Platinum is very rarely found in this country. Some ten years ago Mr. W. Mallet, of Dublin, found crude platinum in minute grains and scales associated with gold, wood tin, &c., in the auriferous sands of some of the Wicklow rivers; about the same time it was also said to have been met with on a farm near the mouth of the river Urr, in Buittle, Kirkcudbright. Platinum has also been found near Loch Camhead.

Explosion at Paris.—On Tuesday afternoon, the 16th inst., at about 3.40 p.m., a most serious accident occurred at No. 2, Place de la Sorbonne, Paris, on the left bank of the Seine, in which premises the cellars and ground floor are occupied by M. Véron Fontaine, manufacturing chemist, as a store and retail shop. During the morning of the above day, there had been delivered at that place a parcel containing 28 kilogrammes of picrate of potash, intended to be forwarded to the experimental sub-

marine torpedo manufacturing establishment, situated on the Isle d'Aix, on the coast of the Département de la Charente Inférieure, there to be employed in experiments. It is not precisely known what caused this material to explode, but it is surmised to be due to carelessness. The violence of the explosion was increased by the fact that a portion of the large quantity of ether and alcohol stored in glass carboys in the cellars of the premises, on their vapour becoming mixed with air, in consequence of the breaking of the carboys by the shock of the explosion, partly exploded, and, becoming inflamed, set the whole building in a blaze. It is authoritatively denied that any picrate of potash was made on the premises; and that neither nitroglycerine nor any fulminates, nor gun-cotton, nor gunpowder were ever in the place at all. The manufactory is situated in the remote outskirts of Paris, in a lonely and secluded spot.

Aniline Grey.—The following recipe has been published by M. Bloch, to produce an aniline grey colour:—1 kilo. of aniline at 190°, and 5 kilos. of arsenic acid in a liquid form at 75°, are taken and heated on the open fire in a cauldron, care being taken to maintain the heat at the boiling point, till the substance thickens and rises, when the operation is terminated and the vessel is removed. The substance obtained presents a blackish appearance; it is thick, and insoluble in water. In order to purify the product, about 20 litres of water, and 1 kilo. of muriatic acid are taken and boiled with steam for half an hour; after which the mass is filtered. The matter which is deposited on the filter is collected, washed with boiling water, and operated upon a third time by a small quantity of carbonate of soda in solution, so as completely to neutralise the acid. Finally, the collected matter is dried, and gives a fine black powder. The solution of this product is made by treating it with alcohol, with an addition of 10 per cent of sulphuric acid. Nothing now remains to be done but to filter it. With this liquor, magnificent greys of all shades are dyed, by submitting its mordant to the dyeing bath. For the dyeing and printing of this grey colour, the matter must first be passed through a water bath, strongly acidulated with sulphuric acid. A skein of silk or wool is dyed by five drops of this liquor.—*Moniteur Scientifique*.

NOTES ON LECTURE EXPERIMENTS.

Sudden Crystallisation.—I should be glad to know the best method of preparing a solution of Glauber's salts for showing sudden crystallisation. My principal difficulty is in avoiding the breakage of the glass flask in which the solution is prepared. I am speaking now of a quantity suitable for a lecture experiment—say a solution containing 10 or 15 lbs. of the salt.—CRYSTAL.

To Burn Oxygen or Air in Hydrogen or Coal Gas, to Show that Combustible and Supporter of Combustion are Relative Terms.—The following simple arrangement does very well indeed for experiments of this character:—A piece of glass tube, a foot or so in length and about an inch in diameter, is fitted with a good cork at each end. Into one of the corks is inserted a short piece of glass tubing, $\frac{1}{4}$ inch in diameter, to which is attached a piece of caoutchouc tubing provided with a pinch-cock. The other cork is perforated, and a metal tube, 2 or 3 inches long and $\frac{1}{2}$ an inch or so in diameter, is inserted into the cork, but does not pass through it. The tube is filled with hydrogen or coal gas. For this purpose it is clamped upright, metal tube downward, and the gas is let in at the top through the caoutchouc tube; when full, a light is applied to the gas at the extremity of the metal tube, and the pinch-cock turned, until the supply of gas is reduced so that there is a small flame only from the metal tube. A glass tube, about $\frac{1}{4}$ inch diameter and terminating in a moderately fine jet, is now connected with a bag, or gas holder, containing oxygen, the oxygen turned on, and the glass jet, with the issuing oxygen, passed through the metal tube into the glass one, when the oxygen, lighted as it enters, will burn in the glass tube containing the coal gas or hydrogen. To burn air, a similar small tube is taken, but with a large jet; the tube is connected by caoutchouc piping with a common pair of bellows, and then, while an assistant gently blows air from the bellows through the glass tube, it is passed through the metal pipe, when the air will burn in the same manner as the oxygen, but with a feeble flame. To burn the breath, an experiment, I believe, shown for the first time by Dr. Odling, the same small tube may be used as the one just now mentioned, air being gently blown

from the mouth while the tube is introduced into the hydrogen. The following are the conditions, or essentials of success, in the above experiments:—(a) The glass tube must be completely filled with gas before lighting, that no explosion may occur. (b) The delivery (glass) tube, connected with the bellows or the mouth, must be sufficiently large, and the air must be driven through the tube gently. (c) In passing the ignited air into the glass tube, the jet should not touch the metal pipe, as it may be extinguished on its passage. A paraffin lamp chimney will serve very well instead of the straight glass tube spoken of, and is, perhaps, more easily obtained. There is one circumstance which mars this experiment to some extent, and that is the deposition of moisture on the interior of the tube, which soon accumulates to such an extent as to prevent the audience from seeing clearly the burning air within. I should be glad of any hint for a method of preventing this deposition of moisture.—C. J. WOODWARD, Midland Institute.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News." A more complete list containing the omitted papers and contents of journals devoted to other branches of science, is published at the Patent Office, in the library of which the periodicals themselves may be consulted.)

Comptes Rendus.
December 7, 1868.

SECCHI, "On some Peculiarities of the Spectra of Solar Protuberances." A. DAMOUR, "Analysis of Adamine from Cape Garonne, Var." A. RICHE, "Researches on the Alloys of Copper and Tin." BERTHELOT, "On the Combination of Free Nitrogen with Acetylene, and on the Direct Synthesis of Hydrocyanic Acid." H. MONTUCCI, "Note on the Lunar Protuberances observed by De Cr  ty at Aden during the Eclipse of the Sun of August 18, 1868."

December 14, 1868.

MOUCHOT, "On the Application of Solar Heat as a Substitute for Fuel in certain Countries." WARREN DE LA RUE, "Observations on Pincus's Claim to the Invention of a Constant Voltaic Battery described by the Author and H. M  ller." BERTHELOT, "On the Formation of Acetylene, and on some other Phenomena of the Action of the Electric Spark on Marsh Gas." C. FRIEDEL, "On a new Mode of Formation of Acetylenebenzene, and on the Homologues of Acetylene." L. TROOST and P. HAUTEFEUILLE, "On Some Properties of Cyanic Acid." FILHOL and MELLIER, "On the Action of Iodine on Certain Sulphides."

Sitzungsberichte der K  niglich Bayerischen Akademie der Wissenschaften zu M  nchen. (Mathematisch-physikalische Classe.)

November 9, 1868.

BUCHNER, "On the Formation of Sulphide of Arsenic in the Corpse of a Person Poisoned by Arsenious Acid." C. VOIR, "On the Formation of Fat in the Animal Body."

December 7th, 1868.

F. VON KOBELL, "On Typical and Empirical Formul  e in Mineralogy." BUCHNER, "On the Composition of the Blood in Cases of Poisoning by Prussic Acid."

Annalen der Chemie und Pharmacie.
November, 1868.

C. BENDER, "On the Behaviour of Oxy-sulphide of Carbon towards an Alcoholic Solution of Potash." J. DUVERNOY, "On Pimaric Acid and its Derivatives." E. G. STRAUSS, "On the Composition of Copaiba Balsam." "On Toluylene-Urea." O. VEIEL, "On the Transformation of Fatty Acids into the Alcohols of the Parallel Series." F. LOSSEN, "On the Oxidation of Acetic Acid to Oxalic Acid." W. HEINTZ, "On Glycocolamide and Diglycocolamidic Diamide." J. WISLICENUS, "On the Brominated Addition Product of Pyroracemic Acid." J. DEMBEY, "On the Transformation of Chlorobenzoic Acid into Oxybenzoic Acid." N. VON DER BRUGGEN, "On the Diethyl Ether of a Dilactic Acid." KRAUT, "On Atropine." "On Cinamic Acid and its Isomer Atropic Acid." E. LINNEMANN, "On the Reduction of Acetic Anhydride to Ethylic Alcohol." "On the Synthesis of Normal Primary Propylic Alcohol of Fermentation." A. SIERSCH, "Researches on the Transformation of Isopropylic Alcohol into Butylic Alcohol." "On Isopropylamine and Diisopropylamine."

Journal fur Praktische Chemie.
November, 1868.

A. H. VAN ANKUM, "On the Essential Oil and the Poisonous Principle of the Root of the *Cicuta virosa*." W. L. CLASEN, "On the Influence of Potash Manure on Beetroot."

December, 1868.

A. RUMPLER, "A Volumetric Method of Estimating Copper." F. VON KOBELL, "On the Crystalline Spessartin of Aschaffenburg, and on a Dense Variety from Pf  tsch." "On a Specimen of Almandine from Northern Columbia." C. F. SCHONBEIN, "On the Occurrence of Active Oxygen in Organic Substances." "On the Transformation of Nitrates into Nitrites by Conferva and other Organic Tissues." "On some Chemical Properties of the Seeds of Plants." "On the Most Delicate Test for Peroxide of Hydrogen." "On the Behaviour of Extract of Malt and Blood Corpuscles towards the Free Oxygen contained in Camphine and in Fatty Oils." "On the Behaviour of Aldehyde towards Ordinary Oxygen." "On the Behaviour of certain Organic Matters towards Ozone."

PATENTS.

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

510. E. Dorsett, London Street, London, "Improvements in means and apparatus for heating, smelting, and working metals, and in furnaces employed therein, which improvements are also applicable to heating, and otherwise operating upon minerals and other substances."—Petition recorded February 19, 1869.

533. T. H. Simmonds, Great Mitchell Street, in the county of Middlesex, and E. B. Moreland, Bartholomew Close, London, "An improved compound for glazing or "finishing" linen-faced paper used in the manufacture of collars and cuffs, and for other purposes."—February 20, 1869.

546. T. S. Blair, Pittsburg, Penn., U.S.A., "Improvements in the manufacture of iron and steel."

548. B. J. B. Mills, Southampton Buildings, Middlesex, "Improvements in the manufacture of artificial stone."—A communication from W. Munroe, Boston, Mass., U.S.A.—February 22, 1869.

565. S. Holroyd, Newton Heath, Manchester, "Improvements in the recovery of substances used in the purification of gas for illumination, and of waste products arising therefrom."

566. H. Bessemer, Queen Street Place, Cannon Street, London, "Improvements in the construction and arrangement of machinery, apparatus, and buildings employed in or for the manufacture or production of cast-steel and malleable iron from pig or other carburet of iron."—February 23, 1869.

574. J. J. Vaughan, Mitre Lane, near Kensal Green, Middlesex, "Improvements in treating, converting, and utilising the metallic salts and sulphuric acid contained in or derived from the residual or waste liquors of tinned plate works and petroleum and paraffin refineries."—February 24, 1869.

586. W. E. Newton, Chancery Lane, "Improvements in furnaces and apparatus for oxidising and desulphurising iron and other ores."—A communication from W. H. Reinhoehl, Pine Grove, Penn., U.S.A.—February 25, 1869.

597. J. A. F. Suter, Hereford, and T. C. Hinde, Fownhope, near Hereford, "Improvements in furnaces and in the combustion of fuel for melting steel, and for other purposes where high temperatures are required."

598. G. J. Hinde, Wolverhampton, "Improvements in coating iron or steel with copper or brass, or other alloys of copper."

600. J. Townsend, Glasgow, N.B., "Improvements in extracting and in refining oils and other products from mineral and other materials containing carbon and hydrogen, and in apparatus therefor."—February 26, 1869.

621. J. Rust, Lambeth, Surrey, "A new or improved composition specially applicable for use for pictorial and decorative purposes."

632. J. G. Willans, St. Stephen's Crescent, Paddington, "Improvements in the manufacture of iron and steel, and in apparatus employed therein."—March 1, 1869.

637. J. Townsend and P. Forbes, Glasgow, N.B., "Improvements in refining or purifying oils and fats."—March 2, 1869.

641. F. A. Gatty, Accrington, Lancashire, "A certain process or processes for obtaining the colouring matter of madder and another useful product."—March 3, 1869.

INVENTIONS PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF COMPLETE SPECIFICATIONS.

670. W. E. Gedge, Wellington Street, Strand, Middlesex, "An improved process and improved apparatus, having for object to preserve from oxidation iron ships and metallic surfaces, or those of copper or iron with which wooden ships are sheathed; also applicable for testing the qualities and the homogeneity of metals."—A communication from E. Demance and G. J. Berlin, Faubourg St. Martin, Paris.—Petition recorded March 5, 1869.

713. H. A. Bonneville, Chauss  e d'Antin, Paris, "A new sort of porcelain, and a new and improved process for manufacturing the same."—A communication from A. Vidal, Rue St. Sauveur, Paris.

NOTICES TO PROCEED.

3226. C. Macmillan, Sunderland, "Improvements in protecting iron ships and other submerged surfaces from corrosion and marine growths, and in compositions to be so employed."—Petition recorded October 21, 1868.

3256. A. Giraud, Gray's Inn Road, Middlesex, "Improvements in separating silver from argentiferous lead, in purifying lead, and in apparatus for the same."—October 24, 1868.

3267. P. M. Crane, Manchester, "An improved compound or size to be used in sizing and dressing cotton yarns or cotton warps."—October 26, 1868.

3309. W. H. Liddell, Edinburgh, "Improvements in treating all kinds of pig skins in the processes of preparation, tanning, currying, enamelling, and japanning, and in utilising the products."

3315. R. Oxland, Plymouth, "Improvements in the treatment of ores and minerals for the extraction of tin."—October 29, 1868.

3352. M. Sautter, Rue de la Chauss  e d'Antin, Paris, "Improvements in preparing and preserving vegetable and animal substances."—A communication from W. O. Giles, New York, U.S.A.—November 4, 1868.

3761. W. S. Jackson, Walworth, Surrey, "An improved method of treating bones and the products obtained therefrom, so as to render them available for various useful products."—December 10, 1868.

370. W. R. Lake, Southampton Buildings, Chancery Lane, "Improvements in puddling and other furnaces employed in the manufacture of wrought-iron and steel."—A communication from S. Danks, Cincinnati, Ohio, U.S.A.—February 6, 1869.

386. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved lining for puddling and other furnaces."—A communication from S. Danks, Cincinnati, Ohio, U.S.A.—February 8, 1869.

NOTES AND QUERIES.

Preservation of Meat.—According to Marchal de Calvi, meat may be kept in a fresh state and without risk of putrefaction by being placed for some fifteen or twenty minutes under a bell jar wherein sulphur has been suffered to burn.

Action of Heat on Zircons.—Henneberg (*Chemical Gazette*, 1847, vol. v., p. 96) noticed that zircons increased in density by being heated, the change being accompanied by phosphorescence and a permanent lightening of colour. Previous to ignition the crystals possessed the specific gravity 4.615, and after ignition 4.710.

Separation of Zinc and Copper.—M. G. C. Wittstein writes, in his *Revue Trimestr.*, that for the separation of zinc from copper the treatment of the sulphides with dilute sulphuric acid may be applied, being the method pointed out by Dr. Hofmann for separating cadmium from copper.

Aniline Green.—It is stated that Dr. Hofmann and Mr. Charles Girard at Berlin have successfully obtained pure aniline green, which green is only distinguished from the aniline violet by the elements of iodide of methyl, so that the violet can be readily converted into the green and the green into the violet.—*Moniteur Scientifique*.

Gardenia Grandiflora.—Can any of your correspondents inform me through the medium of Notes and Queries where a small quantity of the seed of *Gardenia grandiflora* could be procured for experimental purposes? What would be the best means of bringing into notice a method for improving low, greenish qualities of indigo?—CHROMO.

Oil from the Curcas Purgans has been investigated by Da Silva, who states that it furnished him a small quantity of oily alcohol, and that it yields as much as 6.10 per cent of nitrogen. The *Curcas purgans* is an Euphorbiaceous plant, which furnishes a kind of castor oil; it grows in many parts of Africa, and especially in the Cape de Verd Islands.

Desulphurising Coal.—Messrs. Grandidier and Marcel have invented an apparatus for decomposing, by means of the combined agency of heat and compressed air, or heat and high pressure steam, the sulphurets of iron contained in ores, coal, and also coke. The sulphur oxidised completely, without affecting the good qualities of coal or other material submitted to the action of this process.

Influence of Pressure on Chemical Action.—According to experiments and observations made by Cailletet, the strongest acids, properly mixed with water, cease to exercise any solvent action or to disengage hydrogen gas from iron, tin, zinc, aluminium, sulphide of iron (sulphuretted hydrogen gas), when a strong pressure is made to exercise its influence within the vessel wherein the chemical action is taking place.

New Freezing Mixture.—I have made an observation which appears to me of considerable interest. When citric acid and crystallised carbonate of soda, in powder, are stirred together, the mass gets into a pasty state, and in a short time becomes quite liquid. If equivalents of the substances are used, the temperature falls from 60° F. to 8° F. The mixture, for a time, is full of air bubbles, but soon becomes a clear, dense, syrupy fluid. The few cases in which dry solids act on each other at ordinary temperatures give a value to each additional instance.—JOHN GALLETT.

Cement to Resist Red Heat and Boiling Water.—To four or five parts of clay, thoroughly dried and pulverised, add two parts of fine iron filings free from oxide, one part of peroxide of manganese, one-half of common salt, and one-half of borax; mingle thoroughly; render as fine as possible; then reduce to a thick paste with the necessary quantity of water, mixing thoroughly well. It must be used immediately. After application it should be exposed to warmth, gradually increasing almost to a white heat. This cement is very hard, and presents complete resistance alike to a red heat and boiling water.

Another Cement.—To equal parts of sifted peroxide of manganese and well pulverised zinc white add a sufficient quantity of commercial soluble glass to form a thin paste. This mixture, when used immediately, forms a cement quite equal in hardness and resistance to that obtained by the first method.—*Blätter für Gewerbe*.

Chemical Nomenclature.—It strikes me that "H. H." has not clearly expressed what he means. The well-known character of organic radicals has been so abundantly established, and so many have been isolated in subsequent corroboration of their nomenclature, that perhaps it would be unwise to complicate a structure already far too cumbrous; but there are oxy-, chloro-, &c., carbydrogen combinations which I would suggest have been greatly confused and misunderstood by modern chemists in treating them as oxides, chlorides, &c. That we have an oxide or binoxide of (C_2H_4) or (C_4H_4) in the sense that we have oxides of ethyle or methyle, or that these so-called diatomic radicals can replace either H or 2H is what I would most strongly call in question.—S. E. P.

Essence of Patchouli, either when left to itself or when treated with dehydrating substances, yields a camphor which is a black-coloured solid substance, and has a composition which is isomeric with the essence; its composition is represented by $C_{30}H_{26}$, it melts at between 54° and 55° C., and boils at 296°; density = 1.051 at 4.5° C. Vapour density at 324° = 8.00. When essence of Patchouli is heated up to from 282° to 294°, it is entirely converted into this camphor, which is, moreover, homologous with Borneo camphor.

Paraffin.—Dr. Bolley has found that paraffin (a pure sample of which having its melting point at 53° C., and which on analysis, was found to contain in 100 parts—C, 85.61; H, 14.69), after having been kept for eight days at a temperature of 150° C., had become a brownish pasty mass. A portion thereof was soluble in alcohol, and was unaltered paraffin, but the dark coloured residue yielded on analysis C, 70.04; H, 10.25; O, 19.72. A sample of paraffin which had been kept for some time at 300°, gave off vapours on being afterwards again heated up to 150°. Paraffin is, in all probability, a mixture of various hydrocarbons, all of which have varying melting and boiling points.

Welding Copper.—The great obstacle hitherto experienced in welding copper has been that the oxide formed is not fusible. Mr. P. Rust, starting from the well-known fact, that libethenite and pseudomalachite (both native compounds of copper and phosphoric acid) are very readily fusible before the blowpipe, concluded that any salt containing free phosphoric acid or capable of yielding it at red heat would make the weld easy by removing the oxide as a fusible slag. A first trial was made with microcosmic salt (phosphate of soda and ammonia) and succeeded perfectly; as that salt, however, is rather expensive, he substituted for it a mixture of one part of phosphate of soda and two parts of borax, which answers the purpose, although the slag formed is not so fusible.—*Abbreviated from Dingl. Journ.*

Positive or Negative?—A subscriber to the CHEMICAL NEWS deeply sympathises with "A Medical Student." There is no doubt that our manuals on chemistry and electricity are very confused, but they are all right from different points of view—except all the nonsense about negative H, hydracids, &c., which is intensely absurd. He should try and master the essential philosophy of battery action, and be independent of such pitiful guides. Each end of the battery action has two poles—having reference to the fluid half, or to the metallic (wire) half of the circuit. Take the zinc end—it is positive inwards to the fluid, therefore attracts and combines with oxygen; outwards it is negative, and gives off the electricity. Take the copper, platinum, or carbon end—it is negative inwards to the fluid, and attracts, combines with, or liberates the positive hydrogen, while outwards it is positive. The proof consists in this:—That if you insert a decomposition cell (of water) in the metallic half of the circuit, H is given off towards the negative or zinc pole, while O is given off towards the other end. Or, if electro-plating be the object in view, then copper is attracted or precipitated towards the negative or zinc pole, while the copper plate in connection with the positive end of the battery is oxidised to replenish the solution. The subject is both simple and complex, and much more might be said. The question whether the current passes from the copper to the zinc plate (which way?) is a puzzle which needs ventilation—but more anon.—CHEMICUS.

Hydroxyl.—Positive or Negative?—Hydroxyl is to be found in the new edition of Miller, p. 257; and in Fownes, new edition, p. 260. How, may I ask you, are we to reconcile the formula of Fownes (OH) with the formula for the peroxide of hydrogen (H_2O_2), in the theory that hydroxyl and peroxide of H are one and the same? "Medical Student" may be certain that there is no real difference of opinion as to the poles of a battery; the conductor from the zinc is the negative pole, from the copper the positive. The various modes of expression adopted by authors have for object, either to set forth more clearly the received opinions, or to convey more correct notions. There arises from these various views an apparent contradiction at times. But the student will avoid confusion of ideas by means of one or more of the following rules:—1st. See whether there is question of the internal or external part of the voltaic circuit. What occurs inside the battery is, as to the so-called current, the opposite of what occurs outside in the conductors. 2nd. Observe if the author is speaking of the metals in the battery. These may be called *positive* and *negative* (zinc and copper), but their conductors are negative (zinc) and positive (copper); the positive metal is the positive end of the battery, but it is the negative pole. 3rd. Examine the text and context, and, if possible, figure to the mind, mechanically, what is stated; thus, e.g., in Ganot's words, imagine the zinc looking at the copper—it is looking at the positive pole. Again, a little lower down, in the text of Golding Bird, an explanation is given of the tables of negative and positive metals, which explanation clears all difficulty.—E. KERNAN, Clongowes, March 22, 1869.

TO CORRESPONDENTS.

R. G. wishes to be referred to the best work on pottery.

E. Kernan.—We were unable to offer any explanation of the phenomena of the spectrum lines spoken of, and inserted the query in the hope that some correspondent would be able to throw some light on the subject.

Communications have been received from J. Spiller; Dr. Adriani; R. Graesser; S. E. Phillips; E. Kernan; H. Stephenson; E. Beanes (with enclosure); W. Jeafferson; F. Andrews; W. L. Sharpe; W. Chapman; F. S. Barry; Archibald Walker and Co.; G. F. Rodwell; R. T. Clarke; W. J. Morgan; A. Baxter; Miss Benwell; J. W. Slater (with enclosure); Dr. R. Oxland (with enclosure).

THE CHEMICAL NEWS.

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ON THE
METHODS AND RECENT PROGRESS OF
SPECTRUM ANALYSIS.*By A. S. HERSCHEL, B.A., F.R.A.S.,
Professor of Natural Philosophy in the Andersonian University of
Glasgow.

THE portion of the solar spectrum which is most generally visible under all circumstances of the atmosphere, and in which the bright-line spectra of the metals obtained with the spark of a Rhumkorff coil are most distinctly seen, is that contained between the Fraunhofer's dark lines A and G, at the least and most refrangible ends of the spectrum as it appears in Kirchhoff's maps, the last of which was published in 1863. The air-spectrum between the poles of an induction coil was subsequently employed by Mr. Huggins in his "Researches on the Spectra of some of the Chemical Elements," published in the *Philosophical Transactions* for 1864, as a standard of comparison with the bright-line spectra of the metals produced together with it in the induction spark. The superior heat of the voltaic arc being found to produce more vivid spectra of the elements and to exhibit lines in the violet portion not usually seen with the induction coil, a blue line in the spectrum of lithium was thus first discovered by Professor Tyndall in addition to the orange line which Dr. Bunsen had detected in it by the application of a Rhumkorff coil. To extend Kirchhoff's scale of reference to the wider range of artificial spectra, the labour of completing the map of the solar spectrum by delineating the violet portion, and comparing it with the voltaic spectra of the chemical elements was carried out by Professor Angström with the assistance of Mr. R. Thalén, at Upsala; and the work was published in the *Proceedings of the Stockholm Academy* for February, 1865. Confining their attention chiefly to the iron spectrum produced by two stout iron poles of a Bunsen battery of 50 cells, the specimen of this metal was found to contain so many bright lines, especially in the violet portion, that, in addition to 73 iron lines found by Kirchhoff and Hofmann to have counterparts in the dark solar lines between A and G, about 220 were added to the number in that space and 170 more between G and H, making the whole number of iron coincidences about 460, to which, it was believed, one or two hundred might have been added, had not the short summer and deficient sunlight in the high northern latitude put an end to their comparisons. With a greater battery power and an equally extensive trial of other chemical elements, whose vapours appear to be present in the sun, the probability was suggested that the innumerable black lines of the solar spectrum, which still remain outstanding when those of iron are subtracted, may at length be accounted for without assuming the existence of chemical elements in the solar atmosphere, with which we are unacquainted on the earth. The solar character of four new sodium lines, which were first pointed out and their coincidence with Fraunhofer's lines was suspected by Mr. Huggins in his researches, was confirmed; while the agreement of a prominent dark line about halfway between G and H, designated *h* by the authors, with a fourth line of the spectrum of incandescent hydrogen was established, proving, with the correspondences of the other lines at C, F, and G, the existence of that element in the sun. The metal manganese was

placed for the first time on the list of solar elements, and 50 new correspondences of calcium lines were noted in addition to those already previously observed by Kirchhoff. In a Swedish work on spectrum analysis,* published in the following year, Mr. Thalén has compiled a very complete chart of spectra of the chemical elements, referred, like the above-mentioned chart of Mr. Huggins, to the bright lines of incandescent air, and continued, as far as they could be traced, to the violet end of the spectrum. It will easily be perceived that the addition of so many characteristic bright lines in the spectra of the chemical elements, by the use of the voltaic arc, by giving greater certainty to the results, facilitates, in a corresponding degree, the practical applications of the spectroscope. Moreover, in order to establish a natural scale for the uniform representation of artificial spectra, Professor Angström last year published a Normal Atlas of the Solar Spectrum,† in which the wave lengths of the Fraunhofer lines are employed to delineate them, so that the spaces between them represent the differences of their wave lengths enlarged to ten million times their natural dimensions. The most refrangible Fraunhofer line, H, occupies a point at 3,933 millimetres, and the least refrangible line, A, a point at 7,185 millimetres on the map, which are ten million times the wave lengths of those lines; and the entire map, consisting of six plates of two lines each, is 11 ft. 6 in. in length. The violet end of the spectrum in this projection is more compressed, and the red end more expanded, than corresponds to their natural appearance. If, however, in place of the wave lengths the number of impulses in a second, or their scale of pitch, as in musical notes, were employed for projecting the Fraunhofer's lines, a nearly natural representation of the prismatic spectrum would be obtained; and the above objection to the use of the normal scale, which may not, however, be of very great theoretical importance, might yet practically be removed with some advantage. A series of elementary bright-line spectra, showing their counterparts among the solar lines, is laid down in the margin of the map, with the following numbers of the corresponding lines of each, in their correct places on the scale, viz.:—Iron, 450; titanium, 116; calcium, 68; manganese, 63; nickel, 35; cobalt, 19; chromium, 18; barium, 10; sodium, 9;‡ magnesium, 7; copper, 7; zinc (blue lines), 2; aluminium (violet lines), 2; hydrogen, 4. By a series of remarkable coincidences, if not of absolute agreements, twenty-four lines of titanium, twenty-one of calcium, and four lines of manganese are represented in the map as corresponding exactly in their positions with iron lines. A similar agreement between a double line of nitrogen and a double line of oxygen was observed by Mr. Huggins in the spectrum of incandescent air,|| but as the correspondence appeared, on closer examination, not to be absolutely perfect, it was shown to be probably an accidental, although certainly a most curious coincidence. In Angström's Normal Atlas the air spectrum is placed on a parallel line with the solar spectrum, extending throughout its length, so as to include the lines of the elementary spectra between them. The comparison of the latter with either of the two standard scales is, accordingly, made a matter of easy reference. At the end of the atlas is placed a chart of the atmospheric dark lines and spaces of the solar spectrum, a large number of which are now known to owe their presence in it to the absorption produced by aqueous vapour in the earth's atmosphere. This cloudy group of lines is well characterised by Mr. Thalén as forming a faint ground, from which the two solar lines of the

* "Spectralanalys, Exposé och Historik; Med en Spektrelkarta." Af Rob. Thalén, Upsala, Edquist & Berglund, 1866.

† "Spectre Normal du Soleil;" par A. J. Angström, Upsal, 1868. The plates are drawn by Mr. Thalén.

‡ Three of the new lines of the sodium spectrum are double, like the familiar D line, and the fourth is a narrow nebulous line, making the total number of nine separate bright lines in the spectrum of this vapour.

|| "Researches on the Spectra of some of the Chemical Elements." *Philosophical Transactions* for 1864, part ii.

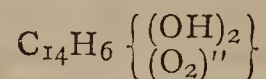
* Abstract of a paper read before the Chemical Section of the Philosophical Society of Glasgow, on Monday, March 1st, 1869.

inverted metallic spectra, tolerably deep black and well defined, stand out, as if seen in perspective, in strong relief. In place of the four glass prisms used by Mr. Kirchhoff in his researches, a single bisulphide of carbon prism with a refracting angle of 60° , a collimator, and an astronomical telescope, each magnifying forty times, were found to be a sufficiently powerful apparatus to distinguish all the lines shown in Kirchhoff's maps, and to add to them the numerous lines recorded in the above-mentioned drawings by Mr. Thalén. From the foregoing description of their recent publications it will be seen that the operations of the Swedish observers continue to afford fresh data of practical value to spectral analysis, as well as some very important contributions of a novel and interesting kind to spectroscopic science.

ON THE ARTIFICIAL PREPARATION OF ALIZARINE.

At the meeting of the Chemical Society of Belgium on the 24th of February, 1868, MM. Graebe and Liebermann communicated a memoir on alizarine, from which an intimate relation was acknowledged between this colouring matter and anthracene. By heating alizarine, according to M. Baeyer's method, with zinc dust, they obtained, as the sole product of reduction, a hydrocarbon having the composition $C_{14}H_{10}$, and presenting all the qualities of anthracene.

This curious fact caused alizarine to be considered as a derivative of anthracene. It also led MM. Graebe and Liebermann to reject the formula, then very generally allowed for alizarine, $C_{10}H_6O_3$, and to admit for this body the composition $C_{14}H_8O_4$, which they expressed by the rational formula—



Having thus obtained anthracene as a product of alizarine, MM. Graebe and Liebermann have since succeeded in solving the inverse problem, that is to say, the artificial preparation of alizarine by means of anthracene. The following account of their new discovery is published by these chemists in the *Rapports de la Société de Chimie de Berlin* (January 11th, 1869).—

"The properties of our product, as well as the colours which it has given us on mordanted cotton, prove the complete identity of artificial alizarine with that from madder root. We submit to the inspection of the Society samples of the colouring matter in a sublimed state, as well as specimens of cotton which have been dyed with this product. The proceedings which led us to this synthesis, and which we shall hereafter describe, confirm the exactitude of the rational formula previously proposed by us for alizarine. It is useless to insist on the importance which our discovery will possess when the means are found to render it universally applicable. The enormous consumption of madder in the printing of tissues, the large tracts of fertile soil made use of for its cultivation, are so many witnesses of the importance which a new trade would have, founded on the artificial preparation of alizarine by means of a material contained in the oil of coal tar."

It appears, according to further accounts from Berlin, that Messrs. Graeger and Liebermann, in order to obtain alizarine from anthracene (paranaphthalene), convert that hydrocarbon into alcohol, and the alcohol into an acid, (lizaric acid and alizarine being synonymous), by acting upon the hydrocarbon with chlorine or bromine, and next effecting a double decomposition by means of acetate of potassa and caustic potassa; after which again an oxidising agent is made to act upon the alcohol so obtained. We think we may state that the gentlemen above named prefer the oxidising action of chlorate of potassa and hydrochloric acid.

RESEARCHES ON GASEOUS SPECTRA IN RELATION TO THE PHYSICAL CONSTITUTION OF THE SUN.*

By Dr. E. FRANKLAND, F.R.S., and J. NORMAN LOCKYER, F.R.A.S.

THE authors have carefully studied the spectrum of hydrogen under varying conditions, with a view of detecting whether or not there existed a line in the orange, and to determine the cause to which the thickening of the line F is due. They failed to detect any line in the hydrogen spectrum near the line D. As regards the thickening of the line F, they have convinced themselves that the widening out is due to pressure, and not appreciably, if at all, to temperature *per se*. Having determined that the phenomena presented by the line F were dependent upon and indicated varying pressures, the authors were in position to determine the atmospheric pressure operating in a prominence, in which the red and green lines are nearly of equal width, and in the chromosphere, through which the green line gradually expands as the body of the sun is approached. With regard to the higher prominences, they have ample evidence that the gaseous medium of which they are composed, exists in a condition of excessive tenuity, and that at the lower surface of the chromosphere itself the pressure is very far below the pressure of the earth's atmosphere. The bulbous appearance of the line F may be taken to indicate violent consecutive currents, or local generations of heat, the condition of the chromosphere being doubtless one of the most intense action. According to the hypothesis based upon Kirchhoff's researches and examination of the solar spectrum, the photosphere itself is either solid or liquid, and is surrounded by an atmosphere composed of gases and the vapours of the substances incandescent in the photosphere. Instead of this compound atmosphere, the authors of these researches have found a gaseous envelope, by which nearly, or at all events mainly, the spectrum of hydrogen is given; while the tenuity of this incandescent atmosphere is such, that it is extremely improbable that any considerable atmosphere, such as the corona has been imagined to indicate, lies outside of it. With regard to the photosphere itself, so far from being either a solid surface or a liquid ocean, that it is cloudy, or gaseous, or both, follows both from their observations and experiments.

ON THE REFRANGIBILITY OF THE BRILLIANT YELLOW RAY OF THE SOLAR ATMOSPHERE.

By M. G. RAYET.

I HAVE lately been enabled to determine in a very exact manner the position of this brilliant line by means of a very dispersive spectroscope and a fine wire micrometer. By taking, as unity, the distance, $D'D''$, between the two lines of group D, the number 2.49 is found as equivalent to the distance between the brilliant line at D, and the most refrangible of the D rays. The probable error in this result is less than 0.03.

The brilliant yellow line corresponds to the division 1016.8 of the scale of the Kirchhoff spectrum. Adopting for length of wave of the lines D' and D'' 0.00059053 m.m., and 0.00058988 m.m., that of the brilliant line is 0.00058827 m.m. The yellow line may be seen upon the whole circumference of the solar disc quite as easily as the three lines of hydrogen: the incandescent gas to which it corresponds is therefore of the same character as hydrogen, one of the constituent elements of the solar

* Abstract of a paper presented to the Royal Society, February 11th, 1869.

atmosphere. At the point where the brilliant ray appears no black line has yet been perceived.

The mode by which I have daily examined the solar atmosphere was as follows:—I employed an equatorial with an object glass, of a focal length of 5 metres, and which was diaphragmed down to 8 centimetres. The telescope was thus rendered quite achromatic, and the difference between the brilliancy of the image of the solar disc and that of its atmosphere was greatly reduced. At the principal focus, where the clear image of the sun fell, was placed the very narrow slit of a direct vision spectroscop; the astronomical telescope, which serves in the latter instrument to examine the spectrum, is movable around an axis which is parallel with the edges of the prisms, and it is quite easy to keep only a small region of the spectrum within the field of vision, namely, that containing one of the brilliant lines. I have also placed between the object glass and the slit of the spectroscop a direct vision prism, itself preceded by a narrow slit. This arrangement is very advantageous as regards a clear view of the yellow line. In this case there is formed an imperfect image a little farther off than the principal focus of the object glass, and from this a determined colour is thrown upon the slit of the spectroscop.—*Comptes Rendus*.

ON NEW EXPLOSIVE POWDERS.

By M. DESIGNOLLE.

(ABSTRACT.)

MANY improvements having lately been made in the art of war, and particularly in the adoption of breech-loading arms, the want has been felt of new powders to meet the requirements of the present artillery. This want has been supplied by M. Designolle, who has invented a new system of powders of which carbazotate or picrate of potash is the base. These powders are of four kinds—viz., a musket powder, gunpowder for short bore cannons, slow gunpowder for cannons with long bores, and an explosive powder for torpedoes and projectiles destined for the undermining of fortifications. The principal advantages of these new powders are the following:—Increase of ballistic power without increase of explosive power; the base remaining the same, possibility of regulating and varying the effects between the limits of one to ten; also of regulating, at will, the rapidity of combustion of this powder, and of increasing the ballistic power without changing the mode of manufacture. Other advantages are—regularity in the manner of action; suppression of sulphur, and consequently of the vapours of sulphide of potassium and sulphuretted hydrogen; absence of action on metals and almost entire suppression of smoke. Into the explosive powders only two components enter—picrate of potash and nitrate of potash; the musket and gun powders contain carbon in addition to the above-named ingredients. To prepare these powders, the ingredients are beaten from three to six hours with a proportion of water varying from 6 to 14 per cent, according to the nature of the mixture; the powder is condensed by means of the hydraulic press, with a pressure of from 30,000 to 100,000 kilos., graining of the powder, and pressing and drying it according to the methods employed for the black powder. In order to increase the ballistic power, the relative proportion of picrate of potash in the mixture must be increased. For musket powder it has been proved that not more than 20 per cent of picrate of potash is required, while for gunpowders its proportion varies from 8 to 15 per cent. This component (picrate of potash) is of a beautiful golden yellow colour, and crystallises into prismatic needles possessing a brilliant reflection; it is insoluble in alcohol, but soluble in about 260 parts of water at 15° or 14 parts of boiling water. Heated with care it becomes orange red at a temperature of 300°, but, on cooling, it assumes its original colour. Heated to 310°, it detonates with

violence. The researches of M. John Casthellaz on the action of nitric acid on phenic acid improved the method of manufacturing picric acid, and produced chemically pure picrate of potash at such a reasonable price that the new powders are not more expensive than ordinary black powder.

MM. Designolle and Casthellaz give the following proportions for preparing deflagrating mixtures with coloured flames:—

Golden fire	Picrate of ammonia	50
	Picrate of iron ..	50
Green fire	Picrate of ammonia	48
	Nitrate of barytes	52
Red fire ..	Picrate of ammonia	54
	Nitrate of strontian	46

—*Bulletin de la Société d'Encouragement*.

ON THE IMMEDIATE ANALYSIS OF DIFFERENT VARIETIES OF CARBON.

By M. BERTHELOT.

(Continued from page 148).

III. CARBON SEPARATED FROM ITS DIFFERENT COMBINATIONS.

I extracted carbon from its combinations with hydrogen, chlorine, sulphur, nitrogen, oxygen, boron, and metals, varying as much as possible the conditions of the separation.

1. *Hydrocarbon Combinations*.—These I decomposed by heat alone, by the electric spark, and by chlorine, oxygen, &c.

Heat.—Carbides of hydrogen, decomposed by passing their vapour through a red hot tube, yield amorphous carbon, which has a metallic brilliancy in that part which adheres to the sides of the tube, whilst the central portion is pulverable and soils paper; both will dissolve in the oxidising reagent, but the metallic portion being more coherent, will require a greater number of treatments: Charcoal furnished by benzenic carbides does not differ in this respect from the charcoal of other carbides—similar facts may be here remembered with respect to charcoal from retorts, wood charcoal, and coke.

The Electric Spark.—I have examined the carbon precipitated by this means in the decomposition of marsh gas; it consisted of amorphous carbon and a small quantity of graphite. I believe the amorphous carbon to be due to the proper decomposing action of heat, and the graphite to that of electricity.

Chlorine.—The carbon precipitated from marsh gas by this means was amorphous carbon, similar to that produced by heat.

Iodine and Iodhydric Acid.—Benzine, naphthaline, and several other carbides, heated to 280° for several days, yield a special charcoaly matter, interesting on account of the low temperature at which it is formed. The charcoaly matters contained in benzine and naphthaline both behave in the same manner. They are easily dissolved by an oxidising agent, and form a yellowish brown compound, very emulsionable, easily precipitated by the addition of a salt, and, in fact, nearer than any other to the state of graphitic oxides, without, however, being capable of total assimilation with them. The charcoal derived from benzine retains this property after being calcined to a white heat in hydrogen; but it does not then acquire the power of furnishing a true graphitic oxide.

Products obtained by oxidising benzinic charcoal with pure nitric acid were subjected to special examination; they are soluble in concentrated nitric acid, but if this be diluted with water, a brown resin is precipitated, whilst an analogous substance is suspended in solution. The

first, when dried, becomes brown and fragile; it deflagrates after the manner of graphitic oxides, but contains nitro elements. On treating this insoluble resin with iodhydric acid at 280° , together with the soluble substance, the result was abundance of gaseous carbides and a few liquid carbides. The simultaneous contact of iodine and iodhydric acid at 280° does not then determine either the formation of graphite, or of a charcoal, transformable into graphite by calcination; but at a higher temperature it is otherwise. The charcoal obtained by the decomposition of iodhydric ether in a red-hot tube does, in fact, contain a considerable quantity of graphite, transformable by oxidation into an oxide analagous to that of electric graphite. With regard to carbon in formation at this temperature, iodine presents the same modifying power by which it so easily changes ordinary into red phosphorus, and soluble into insoluble sulphur.

These conditions of carbon and sulphur are precisely those which are affected by the same elements obtained by the decomposition of their chlorinated compounds.

Oxygen.—Lampblack represents carbon precipitated by incomplete combustion, in which heat and oxidation concur; it has been previously shown to consist of amorphous carbon, with a trace of graphite. The first I attribute to the action of heat, the second to oxidation effected at a high temperature.

I have also examined the charcoaly matter produced by the slow combustion of acetylide of copper at the ordinary temperature; it is entirely dissolved by oxidation.*

2. *Chloride of Carbon.*—Upon decomposing the vapour of perchloride of carbon, C_2Cl_4 , in a red tube, the charcoaly matter obtained was found to be a mixture of amorphous carbon with a considerable quantity of graphite. The chloride of carbon does not, therefore, furnish the same carbon as marsh gas, notwithstanding the analogy of the formulæ C_2H_4 and C_2Cl_4 .

3. *Sulphide of Carbon*, on being decomposed in a red tube, furnishes carbon in thin coherent plates. This carbon contains much graphite, but does not soil paper.

4. *Nitride of Carbon.*—Cyanogen decomposed by the spark only furnishes amorphous carbon with a trace of graphite; the latter I attribute to the influence of the spark.

5. *Carbonic Acid*,—Carbonate of soda is decomposed by heating it with phosphorus. The carbon thus obtained is black and light, and is not attacked by iodhydric acid at 280° . It dissolves by oxidation, leaving a small quantity of graphitic oxide. It may therefore be considered as a mixture of amorphous carbon and graphite.

I also caused sodium to react at a red heat on carbonate of soda; on again taking up the mass with water, the whole dissolves, except a small quantity of carbon, consisting principally of graphite.

6. *Carbide of Boron.*—Carbon is extracted from adamantine boron, by treating it with a current of dry chlorine at red heat. This was effected at two different temperatures—viz., at one inferior to that at which glass is softened, and at one approaching that at which porcelain fuses. In both cases the carbon consisted of graphite, containing no traces of diamond, and transformable into graphitic oxide. The sole difference between the two experiments was that the graphite prepared at dull red heat was amorphous, while that produced at white heat was in hexagonal crystals.

The last-named carbon was deposited partially some distance from where the boron was first placed; this was probably due to the temporary formation of a double chloride of carbon and of boron. Some of the crystals, when examined under the microscope, present the appearance of truncated octahedrons, from the irregular development of their edges; nevertheless, when closely looked at, their form, together with their transformation into graphitic oxide, will remove all doubt.

7. *Carbide of Iron.*—The carbon combined with iron is extracted by two processes—viz., by the action of chlorine at a dull red heat, and with bichloride of mercury. The carbon thus obtained consists in both cases of a mixture of amorphous carbon with a small quantity of graphite. It appears, therefore, that carbon separated from carbides of hydrogen by the action of heat does not contain graphite; while carbon separated from sulphide and chloride of carbon by the action of heat, and from boron by the action of chlorine, contains a considerable proportion of it. Carbon separated from carbonic acid (united with soda) cannot be obtained in a condition equally simple; except in one case, this carbon, isolated either by phosphorus or sodium, also contains a certain proportion of graphite. It is the same with carbon separated from organic compounds by incomplete combustion—that is, by the concurrence of heat and oxidation.

The result of these observations is, that carbon, when separated from hydrogenised combinations, takes the condition of amorphous carbon; whilst that derived from chlorine, sulphur, boron, and perhaps oxygen, inclines to the state of graphitic carbon. Amorphous and graphitic carbons would therefore appear to represent, not different conditions of the carbon itself, but certain polymeric states corresponding with that element.—*Comptes Rendus.*

ON THE WASHING OF PRECIPITATES.*

By Professor R. BUNSEN.

IN the process of filtration as hitherto conducted, the time required is so long and the quantity of wash-water needed so great that some simplification of this continually recurring operation is in the highest degree desirable. The following method, which depends, not upon the removal of the impurity by simple attenuation, but upon its displacement by forcing the wash-water through the precipitate, appears to me to combine all the requisite conditions and therefore to satisfy the need.

The rapidity with which a liquid filters depends, *cæteris paribus*, upon the difference which exists between the pressure upon its upper and lower surfaces. Supposing the filter to consist of a solid substance, the pores of which suffer no alteration by pressure or by any other influence, then the volume of liquid filtered in the unit of time is nearly proportional to the difference in pressure: this is clearly shown by the following experiments, made with pure water and a filter consisting of a thin plate of artificial pumice-stone. The thin plate of pumice was hermetically fastened into a funnel consisting of a graduated cylindrical glass vessel, the lower end of which was connected with a large thick flask by means of a tightly fitting caoutchouc cork. The pressure in the flask was then reduced by rarefying the air by means of a method to be described upon another occasion; and for each difference of pressure, p , measured by a mercury column, the number of seconds, t , was observed which a given quantity of water occupied in passing through the filter. The following are the results:—

p .		I.		pt .
		t .		
metre.		"		
0.179	..	91.7	..	16.4
0.190	..	81.0	..	15.4
0.282	..	52.9	..	14.9
0.472	..	33.0	..	15.6

In the ordinary process of filtration, p on the average amounts to no more than 0.004 to 0.008 metre. The advantage gained, therefore, is easily perceived when we can succeed by some simple practicable and easily attain-

* The acetylide of copper was prepared with acetylene formed under the influence of the electric arc and by means of its elements. I was able to separate, by means of chlorhydric acid, &c., the charcoaly matter which had formed, after keeping several years.

* We are kindly permitted by the proprietors of the *Philosophical Magazine* to copy these portions of Professor Bunsen's paper from their number for January, 1869, where the complete paper may be found.

able method in multiplying this difference in pressure one or two hundred times, or, say, to an entire atmosphere, without running any risk of breaking the filter. The solution of this problem is very easy: an ordinary glass funnel has only to be so arranged that the filter can be completely adjusted to its sides even to the very apex of the cone. For this purpose a glass funnel is chosen possessing an angle of 60° , or as nearly 60° as possible, the walls of which must be completely free from inequalities of every description; and into it is placed a second funnel made of exceedingly thin platinum-foil, and the sides of which possess exactly the same inclination as those of the glass funnel. An ordinary paper filter is then introduced into this compound funnel in the usual manner; when carefully moistened and so adjusted that no air-bubbles are visible between it and the glass, this filter, when filled with a liquid, will support the pressure of an extra atmosphere without ever breaking.

The platinum funnel is easily made from thin platinum-foil in the following manner:—In the carefully chosen glass funnel is placed a *perfectly accurately fitting* filter made of writing paper; this is kept in position by dropping a little melted sealing-wax between its upper edge and the glass; the paper is next saturated with oil and filled with liquid plaster of Paris, and before the mixture solidifies a small wooden handle is placed in the centre. After an hour or so the plaster cone with the adhering paper filter can be withdrawn by means of the handle from the funnel, to which it accurately corresponds. The paper on the outside of the cone is again covered with oil, and the whole carefully inserted into liquid plaster of Paris contained in a small crucible 4 or 5 centims. in height. After the mixture has solidified, the cone may be easily withdrawn; the adhering paper filter is then detached, and any small pieces of paper still remaining removed by gently rubbing with the finger. In this manner a solid cone is obtained accurately fitting into a hollow cone, and of which the angle of inclination perfectly corresponds with that of the glass funnel.

Fig. 1 represents the cones. By their help the small platinum funnel is made. A piece of platinum (Fig. 2 shows the natural size) is cut from foil of such a thickness that one square centimetre weighs about 0.154 grm., and from the centre, *a*, a vertical incision is made by the scissors to the edge, *c, b, d*. The small piece of foil is next rendered pliable by being heated to redness, and is placed upon the solid cone in such a manner that its centre, *a*, touches the apex of the latter; the sides, *a, b, d*, are then closely pressed upon the plaster, and the remaining portion of the platinum wrapped as equally and as closely as possible around the cone. On again heating the foil to redness, pressing it once more upon the cone, and inserting the whole into the hollow cone and turning it round once or twice under a gentle pressure, the proper shape is completed. The platinum funnel, which should not allow of the transmission of light through its extreme point, even now possesses such stability that it may be immediately employed for any purpose. If desired, it may be made still stronger by soldering down the overlapping portion in one spot only to the upper edge of the foil, by means of a grain or two of gold and borax; in general, however, this precaution is unnecessary. If the shape has in any degree altered during this latter process, it is simply necessary to drop the platinum funnel into the hollow cone and then to insert the solid cone, when, by one or two turns of the latter, the proper form may be immediately restored. The platinum funnel is placed in the bottom of the glass funnel, the dry paper filter then introduced in the ordinary manner, moistened, and freed from all adhering air-bubbles by pressure with the finger. A filter so arranged and in perfect contact with the glass, when filled with a liquid, will support the pressure of an entire atmosphere without the least danger of breaking; and the interspace between the folds of the platinum-foil is perfectly sufficient to allow of the passage of a continuous stream of water.

In order to be able to produce the additional pressure of an atmosphere, the filtered liquid is received in a strong glass flask instead of in beakers.* This flask is closed by means of a doubly perforated caoutchouc cork, through one of the holes of which the neck of the glass funnel is passed to a depth of *from 5 to 8 centimetres* (fig. 3); through the other is fitted a narrow tube open at both ends, the lower end of which is brought *exactly to the level of the lower surface of the cork*, to the other is adapted the caoutchouc tube connected with the apparatus (fig. 4) destined to produce the requisite difference in pressure; this apparatus will be described immediately. The flasks are placed in a metallic or porcelain vessel (fig. 3), in the conical contraction of which several strips of cloth are fastened. This method of supporting the flask has the advantage that, in one and the same vessel, flasks varying in size from 0.5 to 2.5 litres stand equally well, and that, by simply laying a cloth over the mouth of the vessel, the consequences of an explosion (which through inexperience or carelessness is possible) are rendered harmless.

It is impossible to employ any of the air-pumps at present in use to create the difference in pressure, since the filtrate not unfrequently contains chlorine, sulphurous acid, hydric sulphide, and other substances which would act injuriously upon the metallic portions of these instruments. I therefore employ a *water* air-pump constructed on the principle of Sprengel's mercury-pump, and which appears to me preferable to all other forms of air-pump for chemical purposes, since it affects a rarefaction to within 6 or 12 millimetres pressure of mercury.

Fig. 4 shows the arrangement of this pump. On opening the pinchcock, *a*, water flows from the tube, *l*, into the enlarged glass vessel, *b*, and thence down the leaden pipe, *c*. This pipe has a diameter of about 8 millims., and extends downwards to a depth of 30 or 40 feet, and ends in a sewer or other arrangement serving to convey the water away. The lower end of the tube, *d*, possesses a narrow opening; it is hermetically sealed into the wider tube, *b*, and reaches nearly to the bottom of the latter. A manometer is attached to the upper continuation of this tube, *d*, by means of a side tube at *d*₁; at *d*₂ is attached a strong thick caoutchouc tube possessing an internal diameter of 5 millims. and an external diameter of 12 millims.; this leads to the flask which is to be rendered vacuum, and is connected with it by means of the short narrowed tube, *k*. Between the air-pump and the flask is placed the small thick glass vessel, *f*, in which, when one washes with hot water, the steam which may be carried over is condensed. All the caoutchouc joinings are made with very thick tubing, the internal diameter of which amounts to about 5 millims., the external diameter to about 17 millims. The entire arrangement is screwed down upon a board fastened to the wall, in such a manner that each separate piece of the apparatus is held by a single fastening only, in order to prevent the tubes being strained and broken by the possible warping of the board. On releasing the pinchcock, *a*, water flows from the conduit, *l*, down the tube, *c*, to a depth of more than 30 feet, carrying with it the air which it sucks through the small opening of the tube, *d*, in the form of a continuous stream of bubbles. No advantage is gained by increasing the rapidity of the flow, since the friction exerted by the water upon the sides of the leaden pipe acts directly as a counter pressure, and a comparatively small increase in the rapidity of the flow is accompanied by a great increase in the amount of this friction. Accordingly, at *g* is a second pinchcock, by which the stream can be once for all so regulated that, on completely opening the cock, *a*, the friction, on account of the diminished rate of flow, is rendered sufficiently small to allow of the maximum degree of rarefaction. Such an apparatus, when properly regulated once for all by means of the cock, *g*, exhausts in a comparatively short time the largest vessels to within

* These flasks must be somewhat thicker than those ordinarily used, in order to prevent the possibility of their giving way under the atmospheric pressure.

a pressure of mercury equal to the tension of aqueous vapour at the temperature possessed by the stream.* The tension exerted by the water-stream in my laboratory, in which six of these pumps are used, amounts to about 7 millims. in winter and 10 millims. in summer. The filtration is made in the following manner:—The flask standing in the metallic or porcelain vessel (fig. 3) is connected by means of the slightly drawn-out tube, *k*, with the caoutchouc tube, *h*, attached to the pump, the cock, *a*, having been previously opened and the properly fitted moistened filter filled with the liquid to be filtered. As usual, the clear supernatant fluid is first poured upon the filter; in a moment or two the filtrate runs through in a continuous stream, often so rapidly that one must hasten to keep up the supply of liquid, since it is advisable to maintain the

After the filter has in this manner been replenished four times with water and allowed to drain for a few minutes, it will be found to be already so far dried, in consequence of the high pressure to which it has been subjected, that without any further desiccation it may be withdrawn, together with the precipitate, from the funnel, and immediately ignited, with the precautions to be presently given, in the crucible.

If the porosity of a paper filter containing a precipitate were as unalterable as that of a pumice-stone filter, the experiments above described would show that the times required for filtration, according to the old method on the one hand, and the new one on the other, would be inversely proportional to the difference in pressure in each case; that is, by using the pump under the full pressure of about 740 millims., the time needed to wash a precipitate, occupying by the old process an hour, would at the utmost not amount to more than 30 seconds. In using these pumice filters (about which I will speak presently) to drain crystals from adhering mother-liquors, or, say, to wash crystals of chromic acid by means of concentrated sulphuric acid and fuming nitric acid, the time occupied in the filtration is scarcely longer than that needed to pour a liquid slowly from one vessel to another. In filtering by means of paper, the precipitate gradually closes up the pores of the filter, and accordingly such an extraordinary acceleration as this can no longer be expected. But the following examples will show the saving of time and labour the method effects, even under all unfavourable conditions. For these experiments I have purposely chosen the hydrated chromium sesquioxide, since it is one of the most difficult of precipitates to wash thoroughly. A solution of chromium chloride was prepared by acting with fuming hydrochloric acid upon potassium dichromate; and by means of a measuring vessel, which allowed the amount of chromium to be estimated to within 0.0001 grm., successive portions of the liquid were withdrawn, and the chromium oxide contained in them precipitated with the usual precautions by ammonia. The volume of liquid, the quantity of ammonia employed, the time occupied in boiling and in permitting the precipitate to settle, the angle of inclination possessed by the funnel, and the size of the filter were the same in all the experiments. All the precipitates were washed with hot water, and, after burning the filter, ignited over the blowpipe for a few minutes; in weighing, the platinum crucible was tared by one of about equal weight, and the position of equilibrium of the beam determined by vibrations.

(To be continued.)

Reducing Aluminium from its Ores.—Mr. A. L. Fleury, of Boston, U.S., mixes pure alumina with gas tar, resin, petroleum, or some such substance, making it into a stiff paste, which is divided into pellets, which are dried in an oven, then placed in a strong retort or tube, which is lined with a coating of plumbago. They are then exposed to a cherry-red heat. The retort must be sufficiently strong to stand a pressure of from 25 to 30 lbs. on the square inch, and be so arranged that, by means of a safety valve or tube, the necessary amount of some carburetted hydrogen gas can be introduced into the retort among the heated mixture, and the pressure of from 20 to 30 lbs. on the square inch be maintained. The gas alluded to is forced into the retort by means of a force pump. By this process the alumina is reduced and the aluminium remains as a spongy mass, mixed with carbon. This mixture is re-melted with metallic zinc, and when the aluminium has collected in a metallic state the zinc is driven off by heat. The reduction is due to the carburetted hydrogen gas under pressure. The time required for reducing one hundred pounds of alumina earth, cryolite, or other compound of alumina, should not be more than four hours; when the gas can be applied in a previously heated as well as strongly compressed state, the reduction takes place in a still shorter period.

Fig. 2.

Fig. 4.

Fig. 5.

Fig. 3.

Fig. 6.

Fig. 1.

filter as full as possible. After the precipitate has been entirely transferred, the filtrate passes through, drop by drop, and the manometer not unfrequently now shows a pressure of an extra atmosphere. The filter may be filled (in fact, this is to be recommended) with the precipitate to within a millimetre of its edge, since the precipitate, in consequence of the high pressure to which it is subjected, becomes squeezed into a thin layer, broken up by innumerable fissures. As soon as the liquid has passed through, and the first traces of this breaking up become evident, the precipitate will be found to have been so firmly pressed upon the paper, that, on cautiously pouring water over it, it remains completely undisturbed. The washing is effected by carefully pouring water down the side of the funnel to within a centimetre *above* the rim of the filter: the washing-flask for this purpose is not applicable; the water must be poured from an open vessel.

* The time required to obtain the above degree of exhaustion in a flask of from 1 to 3 litres capacity ranges from 6 to 10 minutes; the quantity of water necessary amounts to about 40 or 50 litres.

INFLUENCE OF THE
OXIDES OF CHROMIUM AND TITANIUM ON
THE COMPOSITION OF PIG-IRON.

By AUG. A. and S. DANA HAYES,
Assayers to State of Massachusetts.

WITHIN the last four years we have been frequently employed in chemical investigations of the altered characters of some pig-irons, which resulted apparently under the usual circumstances in the reduction of uniform ore.

In these cases the amount of carbon united with the iron had been diminished, without the introduction of other matter, in quantity sufficient to influence a change in this connection, and generally no variation in the composition of the ore was known or suspected. We had analysed the ores in some of the beds in former years and regarded them as well adapted to the production of pig-iron of good quality; but in pursuing the research we were convinced that the change in quality of iron could be traced to altered composition in the ore of part of the beds used for supplying the furnaces.

The correctness of this view was confirmed by our analyses of many iron ores, in some of which we found the oxides of chromium or titanium existing where they were not indicated and connected with the ore in beds which have been considered as pure iron ores.

Both the oxide of chromium and oxide of titanium seem to act in the furnace or the crucible in a way to withdraw a portion of the carbon, or prevent that true union of carbon with a portion of the iron, which constitutes grey pig-iron, without the metals of these oxides really alloying with the iron and thus indicating the cause of change. We have analysed samples of pig-iron where the alloys of chromium or titanium existed in the pigs, and where the oxides accompanied the ores in the beds, but we were not prepared to find an influence exerted on the quality of the pig metal without the refractory metals forming a part of the composition.

The occurrence of oxide of manganese with iron ore is common, and titanium compounds are often found in both magnetic and brown iron ores, as insoluble substances, in small proportions, and these compounds combine with and are removed by the fluxes without injury to the pig metal. These compounds of titanium are the cause of the often superb blue colour of the cinder, produced under varying conditions of glassy or stony character, and must be carefully distinguished from those we regard as more detrimental in their influence on the metal.

In a number of analyses of iron ores we had found both oxide of chromium and oxide of titanium in a state rendering them soluble in diluted acids, and in a condition to escape detection in the ordinary modes of analysis. Both magnetic and brown iron ores have been found to contain either oxide of chromium or oxide of titanium in this soluble state. Among the samples from contiguous beds, this diversity in composition made by the presence of some oxide of chromium or oxide of titanium existed; and while the bulk of a bed of ore was pure, continuations of the bed or associated ore yielded notable weights of oxide of chromium or oxide of titanium in the different samples.

The suggestion we would make to the iron-master in view of these facts, is the possibility of the quality of the pig metals in anomalous cases being greatly influenced by the admixture of some ore containing the oxides of chromium or titanium with the basis ore of good quality. This may take place by the main bed being crossed by veins of mixed ore, or by the workings passing into contiguous beds where one kind of ore is used. In other cases, where the iron the master can gain a great advantage arising from mixing ores, one of the kinds may contain the contaminating oxides and injure the iron.

We subjoin some results of analyses, showing the proportion of oxide of chromium to the metallic iron contained in the ores:—

1st. Magnetic ore—iron, 49; oxide of chromium, 1.40.
2nd. Hæmatite ore—iron, 42.47; oxide of chromium, 1.60.
3rd. Brown Massive ore—iron, 54.32; oxide of chromium, 1.90.
4th. Same—iron, 46.70; oxide of chromium, 1.04.

More traces have been discovered in some cases, while in other instances a larger proportion of chromium formed an alloy with the iron produced from the ore.—*Scientific American.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 18th, 1869.

(Continued from p. 153).

Dr. WARREN DE LA RUE, F.R.S., President, in the Chair.

MR. E. T. CHAPMAN read an abstract of a paper by himself and Mr. Miles H. Smith "*On the Butylic Compounds derived from Alcohol by Fermentation.*" The authors had operated on about 17 gallons of London fusel oil. After subjecting it to a series of fractional distillations, they obtained about five litres of a body boiling within some 3-10ths of a degree; this body consisted of butylic alcohol, contaminated with small quantities of iso-butylic alcohol. The distilling vessel consisted of a tin can of two gallons capacity; its neck was closed by a cork, through which passed a wide glass tube, bent twice at an obtuse angle. From this butylic alcohol, the authors prepared the iodide, bromide, nitrate, acetate, and nitrite of butyl, from which the iso-butyl compounds are separated by fractional distillation.

Iodide of Butyl is a clear, colourless, mobile liquid, boiling constantly at 121°. Its specific gravity is—at 0°, 1.6301; at 16°, 1.6032; at 50°, 1.54816. Ten thousand volumes at 0° become, at 16°, 10,168; and at 50°, 10,529. Instead of heating the crude butylic alcohol with iodine and phosphorus, the authors prepare it by boiling the crude alcohol with four times its volume of hydriodic acid of specific gravity about 1.8. The iodide which separates from the acid is run into a flask containing carbonate of soda and water. The mixture is distilled, and the colourless iodide separated and dried with chloride of calcium and fractionally distilled. It possesses in a high degree the property of splitting up into hydriodic acid and olefine.

Bromide of Butyl is best obtained by saturating the alcohol with gaseous hydrobromic acid. The saturated solution is mixed with its own volume of aqueous hydrobromic acid (sp. gr. 1.6); it is then gradually heated in closed vessels to the boiling point. When the oily layer ceases to increase, the bromide is separated from the acid and distilled with a dilute solution of carbonate of soda; the oily liquid is then separated from the water, dried over chloride of calcium, and fractionally distilled. Its specific gravity is 1.2702 at 16°.

Nitrate of Butyl boils at 123°. Its specific gravity is 1.020 at 16°, and it closely resembles nitrate of amyl. To prepare it, 100 c.c. of a mixture consisting of two volumes of sulphuric acid and one of nitric acid (sp. gr. 1.4) are placed in a beaker standing in cold water and ice. About 30 c.c. of the alcohol are slowly conveyed by means of a tube beneath the surface of the acids, which must be constantly stirred: the nitrate which rises to the surface is decanted into a retort and distilled; it is then separated from the water and dried with chloride of calcium, and if the alcohol was not pure it must be fractionally distilled.

Nitrite of Butyl is a yellow mobile liquid, boiling at about 67°. It is obtained by slowly passing nitrous acid into butylic alcohol, which is kept cool with water. When saturated, the nitrite is washed with water, with dilute caustic potash, and again with water; it is then dried

over chloride of calcium and fractionally distilled. Its specific gravity is at 0°, 0.89445; at 16°, 0.8771; and at 50°, 0.82568; therefore 10,000 volumes at 0°, become 10,198 at 16°, and 10,833 at 50°. One hundred parts of butylic alcohol may be made to yield from 105 to 110 of the nitrite.

Acetate of Butyl is prepared by mixing crude butylic alcohol with glacial acetic acid, saturating with HCl, warming in the water bath, and washing with cold water. The washings are distilled, the distillate treated with carbonate of potash, the oily layer separated and treated again with glacial acetic and hydrochloric acids, and then washed. The acetate is now carefully dried; first by agitation with carbonate of potash, and then by long standing over a new portion of the freshly ignited carbonate; it is then fractionally distilled. Acetate of butyl boils at 117.5; its specific gravity is 0.89096 at 0°, 0.8747 at 16°, and 0.83143 at 50°. Ten thousand volumes at 0° become 10,186 at 16°, and 10,716 at 50°.

Butylic Alcohol.—The authors obtained this most readily by pouring the pure acetate upon about half its weight of caustic soda. After awhile, the mixture boils violently, when it is cooled by immersing the vessel in cold water; water is now added, and the whole distilled. The distillate consists of butylic alcohol, acetate of butyl, and water; it is now saturated with carbonate of potash, the oily portion decanted, and again treated with caustic soda. The mixture is now treated with water and again distilled, the distillate treated as before with carbonate of potash, then thoroughly dried by boiling with and allowing it to cool over carbonate of potash. It must then stand over a large quantity of caustic lime for some weeks, or be digested with it for twelve or fourteen hours, at a temperature between 65° and 75°. On distilling it off the lime, it is perfectly dry; it boils at 108½ at the normal pressure, going quite to dryness below 109°. It was found that it could not be dried with sodium.

Mercury Butyl is easily prepared by the general method given by Frankland and Duppa for the preparation of the mercury compounds of the alcohol radicals. Five grammes of sodium are dissolved in 2,000 grammes of mercury, and agitated with an equivalent quantity of iodide of butyl, to which 1-10th of its weight of acetic ether has been added. The mixture is well shaken; great heat is given out during the reaction. When the bottle is nearly cold, the remaining mercury is poured out in a clean state, and again treated with iodide of butyl and acetic ether. This process is continued till a sufficient quantity of crude mercury butyl is obtained: it is then subjected to distillation. The distillate consists of two layers, the lower of which is mercury butyl, contaminated with iodide of butyl and acetic ether; these are separated by driving a current of steam through it, until no iodine can be detected. The water is then separated, and the compound dried with chloride of calcium. So prepared, mercury butyl is a colourless, transparent liquid of specific gravity 1.7192 at 16°. It cannot be distilled by itself; but it will stand a temperature of 130° without much decomposition.

The authors state that the butyl spoken of throughout the paper, is iso-propyl-methyl; and the alcohol in Kolbe's nomenclature, iso-propyl carbinol; and that the alcohol yields on oxidation iso-butylic acid. The authors base their assertion that they are dealing with butyl compounds on a combustion of the alcohol. Burnt with chromate of lead, 0.3507 gramme of the alcohol yielded 0.8348 gramme of carbonic acid, and 0.440 gramme of water, the following percentages of carbon and hydrogen are calculated:—

				Theory.
C ₄	..	..	64.92	.. 64.87
H ₁₀	..	..	13.94	.. 13.51
O	..	..	—	.. 21.62

A combustion of the iodide obtained from the alcohol was also made. Burnt with chromate of lead and copper turnings, 0.844 gramme of the iodide yielded 0.807 gramme of carbonic acid, and 0.3775 of water. Three iodine de-

terminations were made on three different samples of the iodide prepared at different times: 1.257 grammes yielded 1.6016 of iodide of silver; 0.6904 gramme yielded 0.8839; and 0.8830 of iodide yielded 1.1253 of silver. The following are the percentages calculated:—

					Theory.
C ₄	..	..	26.08	..	26.09
H ₉	..	..	4.97	..	4.89
I	..	..	68.97	(mean)	69.02
			100.02		100.00

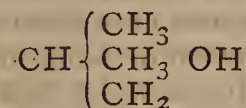
The iodide was also titrated in the manner described by Professor Wanklyn, the digestion being carried on in sealed tubes.

The atomic weights of propyl, butyl, and amyl being C₃H₇=43, C₄H₉=57, C₅H₁₁=71, the authors conclude that a determination of the atomic weight at once points out with which radical they are dealing.

The atomic weights, as deduced from the iodine determinations, are—(I.) 57.43; (II.) 56.55; (III.) 57.4. The atomic weights deduced from the titrations are—(I.) 56.05; (II.) 56.76.

The PRESIDENT said that Mr. Chapman had evidently arrived at some very interesting results, and there were many gentlemen present who were familiar with the investigations made in the same line by Würtz and Butlerow. It was very essential to distinguish between the primary, secondary, and tertiary alcohols, and a discussion of the various points brought forward might eliminate some of the discrepancies which appeared to exist in the physical properties of the substances described by Mr. Chapman and his predecessors. There was evidently some difference as to boiling points and specific gravities, and they were not quite sure they were speaking absolutely of the same substances.

Dr. ODLING corroborated the President's remarks as to the importance of forming a classification of alcohols, and to obtain reactions, by which the class to which an alcohol belonged might be readily identified. He rather objected to some of the definitions occasionally given of alcohols and other bodies in text-books. The definition should be that it is a body which behaves in a particular manner, from which its composition is afterwards inferred. An alcohol which, when oxidised, yields an acid belonging to the ordinary fatty series, is classed as a primary alcohol on that ground; and that is a reaction, or a kind of fact, upon which a definition may be directly based. With regard to classification, he preferred to represent the alcohol on the hydrocarbon from which it was derived as containing the one residue CH, and associated with that the residue CH₃ taken three times, CH(CH₃)₃. The residue CH₃ undergoes that modification in which the hydrocarbon is changed into the alcohol, so that if represented fully it would be



They were acquainted with alcohols in which the residue CH₃ occurs twice and three times, and perhaps only once. If CH₂ was replaced by peroxide of hydrogen, he should consider it a primary alcohol. When one of the H's was replaced by OH, he considered it a secondary alcohol, and the final H being replaced by OH would make it a tertiary alcohol. Mr. Chapman called his alcohol a primary alcohol, because CH was replaced by peroxide of hydrogen, therefore there would be three different classes of primary alcohols, one which contained one, another with two, and a third with three CH.

Professor WANKLYN preferred to classify according to the linking, and to have criteria by which to recognise the linking. The criterion by which a primary alcohol was recognised was, that by oxidation, it gave an acid containing the same number of atoms of carbon as the alcohol itself. By oxidation, the alcohol Mr. Chapman had obtained gave isobutylic acid, which has the same number

of atoms of carbon as the alcohol. This alcohol would be called a pseudo-primary, or an iso-primary alcohol; the proof that it was not the normal butylic alcohol was that the acid formed was not the common butylic acid, but the isobutylic.

Dr. ODLING: What is the proof that the common butylic acid is not the isobutylic, and this the common?

Professor WANKLYN said the proof was two or three years old. Butylic ether, boiled at 119° , isobutylic at 112° . The lime salt of one was more soluble than that of the other.

Dr. ODLING thought Mr. Wanklyn did not understand his question. He asked for the proof that the particular formula applied to the acid Mr. Chapman had obtained, and not to the ordinary?

Mr. WANKLYN said there was a difference in the reaction, and therefore a different formula must be written to express it.

Dr. ODLING would not for a moment be understood to doubt the correctness of the formula, but Mr. Wanklyn had not taken the point of his question. There were two distinct butylic acids, and two distinct butylic alcohols, in addition to a great many more; how did Mr. Wanklyn know that the formula *a* applied to the compound *a*, and not to the compound *b*, and *vice versa*?

Mr. WANKLYN replied that, in addition to the different reactions, there was the synthetical proof. Isobutylic acid might be made from cyanide of isopropyl, and the synthetical proof of the composition of isopropyl gave synthetical proof of the composition of isobutylic acid.

Mr. CHAPMAN said there was also the analytical proof. Isobutylic acid would break up in oxidation while the normal did not. He did not quite agree with Dr. Odling's proposed formulæ. If they had only primary, secondary, and tertiary alcohols to deal with, they only wanted criteria to distinguish those three, and his method of viewing them had the advantage of presenting at one view what was the possible number.

Dr. ODLING observed that, with regard to formulæ, it was a mere matter of preference and convenience which was adopted. As to the other point, Mr. Wanklyn misunderstood his expression. It was not the classification he objected to, but the definition. As a matter of logic, the definition should have reference to the criterion as nearly as possible, so that, in saying whether this body belonged to the *a* or the *b* class, the great thing was to see whether it behaved in a particular way.

Dr. CRUM BROWN felt very strongly the importance of classifying substances and ideas rather according to facts than the particular way in which one might choose to represent the facts. An alcohol was a body which had certain reactions when treated with acids; some yielded by a particular process an aldehyd; some, by oxidation, yielded an acid; then let them be classified by the way in which they yielded these. Let there be a functional classification of alcohols as well as of aldehydes and acids, and then they would get an inverse operation to represent the different classes of alcohols, and get rid of the danger which attended the free use of the atomicity theory. This theory did not seem to be in harmony with the general dynamical principles of science, and therefore it must be replaced by a theory which would have a true place in physics.

Mr. WANKLYN desired to say that in order to classify, it was necessary to co-ordinate the facts. They could only make out what were the relative values of the facts by the theory, and to proceed rationally they must classify from theory, and not from facts.

Dr. GUTHRIE wished to ask Mr. Chapman what was the precise origin of the fusel oil, upon which he had worked. One of the earliest instances of isomerism, viz., the two amylic alcohols, was discovered by Pasteur in working with fusel oil; and therefore Mr. Chapman should have mentioned the precise origin of this fusel oil, whether from potato or grain spirit.

Mr. CHAPMAN was very sorry that he could not answer

that question. Distillers were not given to impart information. In many distilleries mixed grains were employed, and therefore it would be difficult to answer Dr. Guthrie's question. The alcohol and the fusel oil were mixed before he had it, so he could not answer with any certainty what the matter was. He had, however, examined many other specimens of fusel oil, and they all gave symptoms of containing butylic alcohol. If it was found that on treating normal iodide with alcoholic potash no butyl compound was evolved, and that on treating the isopropyl carbinol with alcoholic potash, butylene was evolved, they would have fair ground for making a wide division of the alcohols, and perhaps be justified in calling them hydrates of olefines and alcohols. He wished that the Society would use its influence to obtain a careful arrangement of the already-known chemical data.

The PRESIDENT, in thanking Mr. Chapman for his paper, said that he could not see there would be any good result in promoting the experiments he had proposed. If there was anything treacherous as a basis on which to found an idea of the purity of compounds, it was the boiling point and specific gravity. Seven years experience of his own, which was followed up by Dr. Miller, had led him to the conclusion that they could not place the slightest reliance on them.

GLASGOW PHILOSOPHICAL SOCIETY. (CHEMICAL SECTION).

A MEETING was held in the Upper Hall of the Glasgow Art Gallery on Monday, the 29th inst., at eight o'clock in the evening, W. R. Hutton, Esq., in the chair.

Two new members were admitted by ballot, and one candidate was proposed.

The following papers were read:—"On the Examination of the Flame of the Bessemer Converter," by THOMAS ROWAN, Esq., F.C.S.; "On the Effect of Phosphorus on Iron," by THOMAS ROWAN, Esq., F.C.S.; "On the Quality of Compound Molecules," by J. CAMERON, Esq. We intend to give a further notice of these papers as space permits.

NEWCASTLE CHEMICAL SOCIETY.

THE fourth general meeting of the Society was held on the 25th inst., the President in the chair.

Seven new members were elected. Dr. LUNGE read "Notes on the Progress of Foreign Analysis during 1868." Mr. J. W. SWAN exhibited and described a powerful Holz induction machine.

NOTICES OF BOOKS.

Mémoire sur la Composition Chimique des Monneries Néerlandaises et sur la Volatilisation de l'Argent. Par A. D. VAN RIEMSDIJK, Docteur es Sciences. Pp. 38.

THIS is an abstract, reprinted and separately published from the "Archives Néerlandaises," vol. iii., 1868. The larger work was written and published in Dutch early last year. It treats on a subject which can only satisfactorily be experimentally studied in a well arranged Mint; and Dr. Van Riemsdijk, having that opportunity at Utrecht Mint, has thoroughly gone into matters with great zeal and industry. It will be clear, even to a casual observer, that divers chemical changes must of necessity occur to the alloys intended to be converted into coin during the many operations the alloy is submitted to before it leaves the works; it is simply impossible to melt together two metals, and afterwards again anneal the partly rolled out bars, without some chemical change being called into

play. The various changes and effects also of the blanching and cleaning of the alloys have been studied and experimented upon by the author: he has extended his experiments not only to Netherlands, but also to Belgian, French, Peruvian, Bolivian, and Chilian silver coins. Gold coins are not made at the Utrecht Mint as current Netherlands coins; hence no experiments were made with gold. The author has also investigated the capability of silver, both pure and alloyed, for absorbing and occluding various gases, especially hydrogen and oxygen gas. On the whole, those who work in silver on the large scale, and are interested in the real composition and constitution of the alloyed metal, will find in this paper many very interesting and useful hints, while assayers will certainly read with pleasure the information contained in these pages.

The Voice, and How to Use it. By CHARLES JAMES BISHENDEN, Professor of Singing. London: Published at 52, Mortimer Street, Cavendish Square.

THIS pamphlet treats entirely of the cultivation and preservation of the voice for singing. The author, who has well studied his subject, not only enters fully into the course of practice required, but describes the mechanism of the vocal organs, showing clearly and intelligently the influence they exert; he also recommends careful attention to the diet, which greatly affects the development and power of the voice.

CORRESPONDENCE.

THE NON-PRECIPITATION OF SULPHIDE OF MANGANESE.

To the Editor of the Chemical News.

SIR,—In the short communication which Professor How, of Nova Scotia, addressed to you last week, entitled "On the Non-Precipitation of Manganese by Sulphide of Ammonium in presence of some Organic Ammoniacal Salts," your correspondent evidently writes under the impression that the remarkable behaviour of this metal under the circumstances mentioned by him has not been previously noticed or described, and in giving you his results he naturally refers to them as "possessing novelty and interest." I have, however, to request the favour that you will allow me to point out the fact that the reactions in question formed part of a communication which I read at a meeting of the Chemical Society of London as far back as the 16th of March, 1857. My paper (of ten pages) contains a long inventory of cases in which citric, tartaric, and other organic acids were found to exert important influences on a variety of chemical reactions; and in the title, I specifically referred to these effects as "remarkable circumstances tending to disguise the presence of various acids and bases in chemical analysis." One of the most striking anomalies observed by me was the non-production of the ordinary precipitate upon mixing chloride of barium with a soluble sulphate, when an alkaline citrate was present in the same solution.

The sulphides of manganese, arsenic, and platinum were those which showed to the greatest extent the interfering action of the citrates, and the effect of tartaric acid was observed as being exerted in the same direction. I quote from the *Quarterly Journal of the Chemical Society* two or three paragraphs descriptive of the modified reactions of manganese:—

"Oxide of Manganese.—The most striking result observed under this head relates to the behaviour of the sulphide. The flesh-coloured precipitate usually obtained on adding sulphide of ammonium to a salt of manganese does

not appear under these circumstances, and the sulphide, after precipitation, is freely soluble in an alkaline citrate. If citrate of ammonia be the solvent employed, vapour of sulphide of ammonium is evolved on boiling. The protoxide of manganese is not precipitated by potassa, nor the carbonate by carbonate of soda, in presence of a soluble citrate."

"Tartaric acid prevents the precipitation of a salt of cobalt by potassa, and, in the form of a neutral tartrate, retains in solution sulphate of lead and the sulphide of manganese. Prussian blue is not formed in its presence; and the precipitation of sulphate of baryta is to a small extent retarded."

"Grape sugar, likewise, prevents, in the cold, the formation of sulphide of manganese. Neither cane nor milk-sugar appeared to have any influence in this direction."

It will be seen, therefore, that although the results of Professor How are undoubtedly interesting, they fail to possess also the charm of novelty. Many an old fact has gained importance by being recited, and I think that the suggestion of the interference being due to the production of manganos-ammonium may possibly receive confirmation from the parallel circumstances observed in the case of arsenic, with the alternative of referring them, in other cases, to the existence of a class of double citrates, as indicated in my paper twelve years ago.—I am, &c.,

JOHN SPILLER.

London, March 22nd, 1869.

THE CHEMISTRY OF SUGAR REFINING.

To the Editor of the Chemical News.

SIR,—In your issue of this week, there is a letter from Mr. E. Beanes, which seems to call for a brief reply from me.

Mr. Beanes makes it appear that I "announced" the fact that "acids invert cane sugar" as an original observation, and rejoices in having known it for the last thirty years. I need scarcely state that "the fact" is one of the first with which students of organic chemistry are made acquainted.

Mr. Beanes further states that "our refiners load with calcic carbonate the very carbon surface upon which they depend for the decolourisation of their syrups!" This is, as applied to British refiners, simply absurd. The calcic carbonate, which is not an impurity, as Mr. Beanes states, but an essential constituent of animal charcoal, continually decreases with use, and, occasionally, almost entirely disappears.—I am, &c.,

WILLIAM WALLACE.

Glasgow, March 27th, 1869.

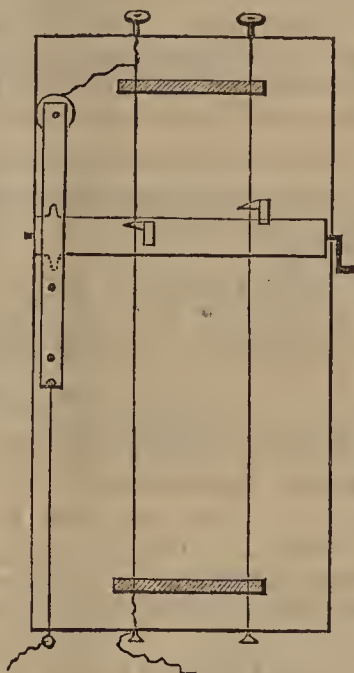
NOTES ON LECTURE EXPERIMENTS.

Sudden Crystallisation.—I think your correspondent "Crystal" would get over his difficulty best by abandoning the large flask and employing a flat medicine bottle full of the solution. This is used as a magic-lantern slide—that is, it is strongly illuminated, and an image formed upon a screen with the aid of a convex lens. I have shown the experiment to very large audiences by employing this method.—ALFRED H. ALLEN, 1, Surrey Street, Sheffield.

Apparatus for Showing the Reciprocal Nature of Combustion.—I have taken much interest in Mr. Woodward's descriptions of lecture experiments, and it affords me great pleasure to be able to help him. The apparatus I employ for showing the reciprocal nature of combustion is modified from that described in Bloxam's "Chemistry." It consists of a paraffin-lamp glass, placed in an erect position and closed at both ends by perforated corks. Through the lower cork pass a narrow glass tube, for the admission of coal gas or hydrogen, and a wide tube of brass extending about half an inch on each side of the cork. The upper end of the lamp glass has a perforated cork and short glass tube, to serve as an exit for the products of combustion. This seems to be missing in Mr. Woodward's apparatus. The coal gas is first turned on full and lighted at top and bottom, and then, by diminishing the supply of gas, a flame of air is obtained at the interior end of the brass tube, and may be exchanged

for oxygen or chlorine at pleasure. By blowing out the upper flame, the apparatus shows the production of acetylene, and by extinguishing the air flame, it affords a good illustration of the theory of the Bunsen flame. No moisture is deposited, the air flame burns continuously, and frequently produces a musical note. Mr. Woodward should admit his coal gas below, and have an exit tube above.—ALFRED H. ALLEN.

A Phonoelectroscope.—A little instrument which I have recently contrived for the purpose of illustrating the heating power of the voltaic current, and which may be fitly called a *phonoelectroscope*, consists of a rectangular wooden box, ten inches by five, two steel or platinum wires stretched from end to end, a small spindle carrying two quill plectra, and an eccentric wheel for making and breaking the current through one of the wires. The wheel turns under a brass spring, which plays upon a button. The spring is connected with one electrode of the battery, the button with the wire nearest to it, and this wire with the other electrode. To exhibit the use of the instrument:—First, tighten the wires, by means of the milled-headed screws, to unison, to about the pitch of middle C.; then turn the spindle so as to sound the two notes in succession before the eccentric wheel makes the circuit. After these have sounded in unison, turn the spindle a little more; the circuit is made by wheel and spring, and presently the plectra play a second time on the wires, which now sound, with an interval of a tone or more, according to the quantity of electricity which has passed through one of them. By regulating the time between the instant when the wires sound in unison and the instant when they sound again, and noticing the musical interval caused by one of them becoming flat, we have an audible measure of the expansion of the connected wire, of the temperature to which it has been raised, and of the quantity of electricity which has traversed it to produce that effect. By continuing the movement, the interval between the notes will increase, and at last the wire operated on will become too slack to sound at all. If connection with the battery be now broken, and the heated wire be allowed to cool, its note will be heard to rise by degrees to its original pitch. With a single pair of plates, the phonoelectroscope answers well. The experiment is a striking one in a lecture-room, very instructive, and easily managed. The apparatus is so simple that anyone almost may make it for himself.—EDWIN SMITH, M.A.



NOTES AND QUERIES.

Atomic Weights.—In former numbers of the CHEMICAL NEWS extended quotations have been given from Professor Stas's minute and masterly researches on "Atomic weights," published in 1860, and it is interesting to notice how closely his results coincide with those deduced from the investigations by Dr. Penny on the same subject in 1839, as shown in the following comparative statement:—

	Stas.	Penny.
Chlorine	35'457	35'45
Nitrogen	14'044	14'02
Silver	107'930	107'97
Potassium	39'137	39'08
Sodium	23'045	23'05

Camphor of Patchouli is quite white, not black, as stated in last number of CHEMICAL NEWS. I have a quantity in my laboratory which any one so interested may see.—SEPTIMUS PIESSE.

Substitute for Black Lead for Fire Grates.—Can any of your readers inform me where to find a description of a kind of paint, made with potassic or sodic silicate, intended to replace the use of plumbago for fire grates?—H. M.

New Colour Test for Blood.—From some experiments made by Professor Bloxam, of King's College, in a public lecture, it appears that a mixture of tincture of guaiacum and ozonised ether (that is to say, a solution of peroxide of hydrogen in ether) instantly produces, with blood or bloodstains, a beautiful blue tint. Professor Bloxam mentioned that he had extracted a single linen fibre, in the case of a blood stain twenty years old, and with an almost inappreciable amount of stain on it; and had found the characteristic blue colour was immediately induced by the test, and readily detected by microscopical examination.—*Lancet*.

New Freezing Mixture.—In the notice among "Notes and Queries" last week of a "New Freezing Mixture," there is an omission of the minus sign before the 8° Fahr., the temperature falling 8° below zero when from two to three ounces of material are used. I also find that the fluid obtained by mixing the powders mentioned in the note becomes solid in a day or two standing in a corked jar. The solid mass has the appearance of set plaster of Paris or damp chalk. The addition of a very little water appears to prevent this setting into a solid mass, but the chalky-looking citrate lies a long time in cold water without being dissolved. Further observations on the subject are necessary and may lead to interesting results.—JOHN GALLETLY.

Action of Leaves on Carbonic Acid.—In order to answer the often-doubted fact of the decomposition of carbonic acid and the formation of oxygen by the leaves of plants, Boussingault has introduced into mixtures of carbonic acid gas and hydrogen and the former gas and nitrogen first a clean stick of phosphorus; as long as no oxygen is present, this element does not undergo slow combustion, thereby giving off vapours, but as soon as a green leaf of any plant was carefully brought into the gaseous mixtures standing over mercury the slow combustion of the phosphorus began, owing to the decomposition of the carbonic acid and formation of oxygen; this action takes place also in diffuse daylight, but not during twilight; leaves wherein the chlorophyll is not fully developed do not act in this manner.

Test Paper for Detecting Minute Traces of Hydrocyanic Acid may be prepared, according to Schönbein, in the following manner:—Good filtering paper is thoroughly soaked in tincture of guaiacum wood containing at least from 3 to 4 per cent of resin. After drying, it is moistened with water containing in solution 0.25 per cent of sulphate of copper; this paper becomes coloured blue as soon as it is placed in contact even with very minute quantities of hydrocyanic acid. Test paper prepared with a solution of iodide of potassium and starch solution, will, when previously also moistened with the above-named solution of copper, become blue when placed into contact with small, otherwise not readily perceptible, quantities of hydrocyanic acid.—*Schweiz. Wochensch. f. Pharm.*

Testing Glycerine for Sugar, Dextrin, Gum, and Glucose.—When glycerine, previously diluted with from 20 to 24 times its bulk of water, is mixed with a few drops of a solution of molybdate of ammonia, while also a few drops of nitric acid are added, the fluid, on being heated to boiling point, becomes coloured blue, when the glycerine has been adulterated with a solution of sugar; when dextrin is present, the reaction is not so marked, and the colour rather more greenish. But Dr. A. Vogel, who investigated this subject, states that the adulteration of glycerine by dextrin and glucose is infallibly detected by the well-known liquid, a solution of a salt of copper to which a solution of tartaric acid and caustic potassa are added, applied to the detection of grape sugar; as for gum, the molybdate of ammonia is a good test. The presence of gum in glycerine is indicated by a more pale blue colour.—*Industrie Zeitung*.

Testing the Decolourising Power of Animal Charcoal.—According to Tissandier, 10 grammes of a good specimen of this material carefully made, and also 10 grammes of the sample to be submitted to experiment, are taken and reduced to a very fine powder; each quantity is then placed on a paper filter of equal size, and next there is poured over the charcoal a quantity of 20 c.c. of a solution of rather dark brown sugar dissolved in water; the same quantity is repeatedly poured over the charcoal until the fluid which passes through the filter is of the same dark colour as the dark coloured sugar solution used. When, for instance, the liquid runs through the normal animal charcoal, as dark coloured as the originally applied solution, after eight doses of 20 grammes each, while such happens to occur with the charcoal to be tested after four of such doses, it is clear that the decolourative effect of the latter is only half that of the former.—*Moniteur Ind.*

Gas Purification.—Mr. Gasch, inspector of gas works at Neunkirchen, Prussia, has made a series of experiments with the view to settle a question which is also of scientific interest, viz., whether carbonic acid is expelled from its combination with lime (as formed in the purifiers of gas works) by sulphuretted hydrogen, or whether the reverse action takes place. The results obtained are the following:—*a.* Carbonic acid expels hydrosulphuric acid from its combination with lime. (The combination of hydrosulphuric acid with lime appears to be CaS,HS). *b.* Hydrosulphuric acid does not expel carbonic acid from carbonate of lime. *c.* When either illuminating gas, coal gas, or atmospheric air are passed through layers of sawdust, carbonic acid is expelled in large quantity, especially at the beginning of the operation, or when the temperature of the sawdust is artificially increased. *d.* Lime, which has been fully saturated with carbonic acid, absorbs hydrosulphuric acid very energetically as long as it is moist, while no gas is expelled from it.—*Journal für Gasbeleuchtung*.

Dilatation of Petroleum by Heat.—M. Sainte-Claire Deville has recently called attention to a danger in respect of petroleum, paraffin oils, and the like fluids in consequence of the very great dilatation these liquids undergo by changes of temperature of the atmosphere no greater than those observed from winter cold to summer heat. Deville advises that casks and other closed vessels containing petroleum should never be filled, as the terms runs, full to the bung, for if this be done with the aforesaid liquids, there is an imminent danger of the vessels containing them being forced asunder by the mere dilatation of the liquid contained in them by an increase of temperature. It is, therefore, especially in cold weather, absolutely necessary to guard against entirely filling casks and other vessels entirely with petroleum and all similar fluids, since the bursting of the vessels may become attended with danger and risk of fire; explosion also may ensue by the vapour becoming mixed with air.—*Abridged from Moniteur Belge*.

Positive or Negative.—"A Medical Student" is suffering from a common form of confusion of ideas and terms. The galvanic current is set up at the surface of the zinc and is due to the force set free by the zinc while displacing hydrogen from the acid. Thus the zinc is the positive plate or element of the battery; the current passes through the liquid to the negative plate or element, the copper, platinum, or carbon, which merely collects the force and transmits it. As the current consists of polarised molecules there is a positive and negative at every point wherever the circuit is opened, and the side of the opening to which the current comes on its road from the zinc through the liquid is always the positive; therefore the wire leading from the negative element of the battery becomes its positive pole, and when

connected to another cell, it is the positive element of that cell; thus, if led to another battery cell, it is continued in the zinc or positive plate; if to a decomposition cell, it is the positive pole or anode, to which proceed the negative portions of the compounds under electrolysis, therefore called anions, which are the chlorous or acid elements and radicals. But they do not go to the anode from any "attraction" in themselves, or if free, they only range themselves in that order of polarity when forming parts of a molecule capable of being polarised and separated into two distinct components, therefore only binary compounds can be directly decomposed by the electric current. The terms zincode and platinode are merely confusing nuisances. The wire from the zinc plate is of course the negative pole of the battery; it is the road by which the electricity returns, to use a common phrase; really it is the completion of the circle of polarised molecules which is the essential character of a galvanic current, for only when that is provided is electricity developed; when chemical action takes place without this condition of a complete molecular chain, heat is developed by the action instead of electricity, in ratios which prove the two to be the same force under different conditions. Thus, in the cells, the current goes from zinc to copper; in the circuit its course is from copper to zinc.—JOHN T. SPRAGUE.

Positive or Negative.—Perhaps I might be allowed to answer "A Medical Student," who, in your impression of March 19, asks for information about the poles of the voltaic battery. In the first place he must remember that the positive element or plate is not the same as the positive pole, in fact, just the reverse, and this, I expect, is what has confused him. Now suppose we have a battery cell, the plates of which are zinc and copper, and the fluid the ordinary dilute sulphuric acid. The zinc is acted upon and oxidised by the acid, but the copper is not; the zinc therefore becomes positive, and the copper negative. A current of electricity would now pass from the Zn to the Cu if it could, but as a current can only pass in a circuit and never in a straight line, the particles of the liquid are merely polarised and put in a state of tension; but if the plates are connected by a wire outside the cell, the circuit is completed, and the current can now pass from the zinc, through the liquid to the copper, thence back by the wire to the zinc. Now it must be noticed that the current inside the battery passes from Zn to Cu; but outside, or in the wire, from Cu to Zn. That pole from which the current starts is called positive; therefore, the zinc is the positive plate or element. But the copper wire is the positive pole, end, or terminal, or the anode; the copper plate is the negative plate, but the zinc wire is the negative pole or the cathode. Those substances which, on decomposition, appear at the positive pole or copper end are termed anions, viz., O, Cl, I, and the acids. Those which appear at the negative or zinc pole are cations, viz., hydrogen, the metals, and combustible substances in general. Once more, the Zn is the positive plate, but negative pole; the Cu is the negative plate, but positive pole.—SIRIUS.

MEETINGS FOR THE WEEK.

- MONDAY, 5th.—Royal Institution, 2. General Monthly Meeting.
Medical, 8.
- TUESDAY, 6th.—Royal Institution, 3. Professor Grant, "On Stellar Astronomy."
- WEDNESDAY, 7th.—Society of Arts, 8.
Pharmaceutical, 8.
- THURSDAY, 8th.—Royal Institution, 3. Professor Tyndall, "On Light."
London Institution, 6.
Royal, 8.30.
Zoological, 8.30.
Royal Society Club, 6.
- FRIDAY, 9th.—Royal Institution, 8. Dr. Carpenter, "On the Temperature and Animal Life of the Deep Sea."
Astronomical, 8.
- SATURDAY, 10th.—Royal Institution, 3. A. Geikie, Esq., "On the Origin of Land Surfaces."

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Extracts from the Report of the Directors, presented at the Annual General Meeting held on the 27th November, 1868:—

1. The sum of £412,345 was proposed for Assurance, of which £307,395 was completed, at Premiums producing £10,067 per Annum.
2. The amount paid under Claims by death was £100,883, being the smallest since 1860, whilst the expenses of management and all other outgoings were even less than for many years past.
3. On the other hand, the Income was raised to £219,769, notwithstanding that its increase was retarded by abatements of premium which did not take effect in the previous year, and by the cessation of interest on the large sum paid as Bonus in 1867.
4. The Surplus income was very considerable. It amounted to £93,152, a sum exceeding by more than £8,000 any previous Surplus during the forty-four years of the Society's existence.
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THE CHEMICAL NEWS.

Vol. XIX. No. 488.

CONTRIBUTIONS TO ANALYTICAL CHEMISTRY.*

By Dr. E. FLEISCHER, of Dresden.

THE SYPHON FILTER.

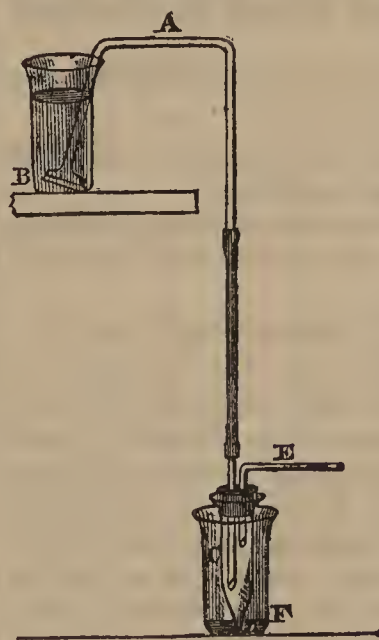
THE operation of filtering gelatinous precipitates is well known to be one which consumes much time, especially when, as is frequently the case, it is desirable that the deposit should be thoroughly washed. Neither will decantation materially hasten the operation, because most gelatinous precipitates (especially alumina) settle only very slowly, and not always clearly, so that the supernatant liquid must still be filtered in most cases. Granular deposits also retard filtration to a considerable extent, as soon as the filter employed becomes only partially filled with them.

Lastly, the washing upon the filter of a not inconsiderable number of precipitates is always a very uncertain affair, because the washing water by no means always penetrates the entire mass, but much oftener finds out for itself certain channels which afford it an easier passage through the filter. All these drawbacks may, however, be remedied by using, instead of the ordinary filter, an instrument which filters and decants at the same time. A similar kind of filter, which I shall call the syphon filter, because it is founded on the principle of the syphon, has often been proposed for use in rapid filtration; nevertheless, among all these contrivances, we do not possess one of a suitable form for analytical purposes, although many may be used for manufacturing operations, especially on a proportionately large scale. I, on the contrary, have taken some trouble to render this principle of the syphon pressure applicable to quantitative estimation, and subjoin a description of my syphon filter as now manufactured according to my own plan by the well-known firm of Franz Hugershoff in Leipzig.

A is a double bent funnel; each bend is 1 decimetre long: the height of the receiver-shaped funnel is little more than 2 centimetres, the width 3 centimetres. This syphon is joined at its free end to an india-rubber tube united to a straight glass tube, so that the length of the entire shank of the syphon is made to approach 50 centimetres. The glass tube which is joined to the india-rubber pipe passes through a doubly perforated india-rubber stopper which fits into the pipe, c, which tapers to a point. The second hole in the stopper contains the suction pipe, E, which only just passes through and is bent at right angles.

In order to filter, there must first be spread over the mouth of the funnel a suitable round piece of muslin and upon that a similar piece of filtering paper; the muslin must be alike unaffected by acids or alkalis. Both filtering media must then be held by means of a tight india-rubber ring in the bell-shaped funnel; the filtering medium is sprinkled with distilled water and placed in the beaker, which serves to receive the substance to be filtered. It will be necessary in order that as little fluid as possible may be left behind in such filtrations, and that no unnecessary quantity of water be used in washing, that certain dimensions which have proved to be the best should be adhered to in this vessel; success will then be certain. It will conveniently contain 100 c.c., and the quantities of liquid which are left from such filtrations and which contain the deposit amount to scarcely more than 5 c.c. Even when B contains no deposit there does not remain more than 7 c.c. at most after filtering the clear liquid; but since the vessel is filled each time with at

least 100 c.c. of the liquid, the residue will amount to 1-20th of the fluid used, so that a deposit, after threefold washing contains only 1-150,000th of the substance which was disseminated and contained in the original mass. It will be seen by this that in most analyses one washing instead of three will give a sufficiently pure residue; the washing water may also be more completely utilised than by employing the ordinary funnel filter, because it can be better agitated with the deposit. Lastly, the filtering surface always remains pure, because the filtration takes place from beneath to above, and in consequence of this and of the considerable pressure of 50 c.c. of liquid, the filtration takes place in about one-fifth of the time required when using the ordinary filter instead; since there is an average discharge of 20 c.c. of liquid per minute. The process of filtering is as follows:—B must be placed upon the table at such a height as to be convenient for stirring and filling; the vessel, F, which receives the filtrate stands lower. As soon as B is filled the suction pipe, E, must be exhausted, and at the same time the opening, O, must be closed with the fore-finger; when the liquid has arrived in the india-rubber pipe, F is placed under it and the filtration continues as long as the filtering medium is covered with liquid. When this is no longer the case, B is again filled with the liquid or substance to be filtered, and the whole well agitated by repeatedly raising and lowering the funnel. One filtration being finished, the funnel is washed, together with the paper over B, which in order to preserve the last drops of the liquid, is held up and pricked. If it be desired to ignite and weigh the residue, it must be washed out of B into a small platinum dish, which is then placed over a water bath to evaporate all moisture, and heated either in the dish itself or in a porcelain or platinum crucible. The desiccation in the drying room may be omitted and also the burning of the filter, as they would take up too much time. Should it be necessary for a deposit to be again dissolved, one great convenience



of this contrivance is, that at the end of the filtration it will be found ready in the beaker with a minimum quantity of water, thereby removing the inconvenient rinsing out of the filter, a part of the process which in the case of strongly adhering deposits requires large quantities of water.

These are the essential advantages of the syphon filter I always employ it if the fluid to be filtered amounts to more than 100 c.c., or if a voluminous deposit is to be washed.

SPECTROSCOPIC OBSERVATIONS OF THE SUN

By J. NORMAN LOCKYER.*

No. III.

IN a former paper† the author stated that Dr. Frankland and himself had searched without success for the known third line of hydrogen in the spectrum of the chromosphere. He has now discovered that the position of the third line is at 2796 of Kirchhoff's scale. The author assumes that the darkening of the limb is due to the general absorption of the chromosphere, and therefore it follows:—

1. That the additional selective absorption near the limb is extremely probable.
2. That the hydrogen Fraunhofer lines indicating the absorption of the outer shell of the chromosphere will vary somewhat in thickness: this he found to be the case to a certain extent.

* Abstract of a paper presented to the Royal Society, March 4th, 1869.
† CHEMICAL NEWS vol. xix, p. 158.

* Communicated by the Author.

3. That it is not probable that the prominences will be visible on the sun's disc.

On the 20th of February a spot was observed in which the *general* absorption was so great that the several lines could only be distinguished with difficulty, except in the very brightest region, which is ascribed to the greater length of the absorbing medium in the spot itself in the line of sight when the spot is observed near the limit instead of the centre of the disc.

Mr. Lockyer has succeeded in adding magnesium and barium to the material (sodium) to which he referred in paper No. 1 (published in 1866). He no longer regards a spot simply as a cavity, but as a place in which principally the vapours of sodium, barium, and magnesium occupy a lower position than they do ordinarily in the photosphere. It therefore follows—

1. The lines of sodium, magnesium, and barium, when observed in a spot, are thicker than their usual Fraunhofer lines.

2. The lines of sodium, magnesium, and barium, when observed in the chromosphere, are thinner than their usual Fraunhofer lines.

These facts give additional evidence that a spot is the seat of a downrush—a downrush to a region, as we now know, where the selective absorption of the upper strata is different from what it would be, and indeed is elsewhere at a higher level.

The author thinks there are two causes for the darkening of a spot, viz.:—

1. The general absorption of the chromosphere thicker here than elsewhere, as the spot is a cavity.

2. The greater selective absorption of the lower sodium, barium, magnesium stratum, as the surface of its last layer is below the ordinary level.

Mr. Lockyer is waiting to make observations with the large Stenheil spectroscope to finally test the accuracy of the valuable suggestion of Messrs. De La Rue, Stewart, and Loewy in their "Researches on Solar Physics," that if the photosphere of the sun be the plane of condensation of gaseous matter, the plane may be found to be subject to periodical elevations and depressions, and that at the epoch of minimum sun-spot frequency the plane might be uplifted very high in the solar atmosphere, so that there is comparatively little cold-absorbing atmosphere above it, and therefore great difficulty in forming a spot.

With a rapidly oscillating slit the author was not satisfied with his results, but on hearing that Mr. Huggins had succeeded in seeing the form of the solar protuberances by using absorbing media and a wide slit, he was led to try the wide slit without the absorptive media, and in the following words he describes the results:—"The solar and atmospheric spectra being hidden, and the wide image of the slit alone being visible, the telescope or slit is moved slowly, and the strange shadow-forms flit past. Here one is reminded by the fleecy, infinitely delicate cloud-films of an English hedge-row with luxuriant elms; here of a densely intertwined tropical forest, the intimately interwoven branches threading in all directions, the prominences generally expanding as they mount upwards, and changing slowly, almost, indeed, imperceptibly. By this method the smallest details of the prominences and of the chromosphere itself are rendered perfectly visible and easy of observation."

In an addendum dated March 17th, the author states that more favourable weather had enabled him to continue his researches in reference to his method for viewing the prominences, and to view the injection of sodium, magnesium, &c., into the chromosphere. He thinks that in time it will be possible to see the prominences as they really are seen in an eclipse by constructing a rapidly revolving wheel with red, green, and violet glass of the required absorptions, in which the percentages of light of each colour may be regulated. On the 14th of March, with a tangential slit, a fine dense prominence near the sun's equator on the eastern limb was observed,

ON THE

EXAMINATION OF THE "FLAME" OF THE BESSEMER CONVERTER.*

By THOMAS ROWAN.

THE Bessemer process for the manufacture of steel is now among the most important of our metallurgical operations. On account of its comparatively recent introduction among established industries, it affords an ample field for scientific investigation, and there is no feature of the process at once so interesting and important as that of the flame which issues from the "converting vessel."

The success of a "blow" undoubtedly depends on the accuracy and completeness of many details, but of them all, the most important is to know and catch that moment in the existence of the flame when the carbon in the iron has yielded its last trace to the oxygen of the air.

If a charge is "over-blown"—that is, if it be subjected to the action of the air for too long a period, or if it be "under-blown"—that is, if the admission of air is stopped before the proper chemical action has been completed, the steel will be found to be defective in proportion to its unskilful treatment.

The flame issuing from the converter is the index of these changes which the molten mass of metal is undergoing during the process; but the exact moment of decarburisation is often, from a variety of causes, difficult to determine.

It is for these reasons that the examination of the flame forms the point of attraction of the process; and I have thought it might not be uninteresting to the members of this Society to describe to them the general appearance which this flame presents to the eye, and some experiments which my brother has made with the spectroscope and with coloured glasses, for the purpose of more readily determining that critical period or "change" in the flame which I have spoken of. The success of these latter experiments has enabled him to obtain the object for which they were commenced; and he has designed an instrument, which I shall describe hereafter, by which the change in the flame is more easily determined.

1st. *The General Appearances of the Flame to the Eye.*

When the vessel is first turned up, a shower of brilliant sparks is ejected, owing to the force of the blast reaching first a thin layer of metal as the vessel slowly swings round to the vertical position.

From 0 to 3 or 4 minutes.—When the full head of metal is over the blast, at first, for three or four minutes, there is scarcely any flame, only a current of very hot gases and very numerous sparks.

From 3 or 4 to 5 or 6 minutes.—Gradually a small pointed flame appears in the centre of the sparks, and this quickly increases in size, without gaining much brilliancy for two or three minutes.

From 5 or 6 to 9 or 10 minutes.—During the next period of four or five minutes the flame is very unsteady, both in size and in position, and its oscillations are accompanied by hollow sounds, as of reports or explosions in the interior of the converter.

From 9 or 10 to 11 or 12 minutes.—Streaks, or flashes of brighter flame now shoot up through this comparatively non-luminous flame, and, within one or two minutes, give place to a continuous stream of dense and brilliant fire, which rushes far up the chimney and illuminates the entire building, often casting the shadows of the cranes, &c., against the windows through which the sun is shining.

From 11 or 12 to 15 or 16 minutes.—This flame gradually becomes thinner and more transparent, without losing any of its brilliancy during the six or seven minutes of the blow which generally remain, until it suddenly

* Read at the meeting of the Chemical Section of the Glasgow Philosophical Society, March 29, 1869.

(preceded, however, by a few hollow and peculiar sounds from the interior of the vessel) loses its brilliancy and much of its size, and drops down, within about half a minute, to about the size it had reached at about five minutes of the blow; this flame however, being more dense and more luminous than the flame at that earlier period.

Any of the stages described may, from a variety of causes, be prolonged; or an insufficiency of blast, however caused, may lengthen the entire period of the blow for several minutes, but the above is a fair average blow with the best English hæmatite pig-iron. If inferior irons are used, the flame at the change is more or less enveloped in a dense white smoke, and the change is accompanied by violent pulsations, or "coughings," of the entire flame, which, under these circumstances, has often a yellowish red colour to the eye; all this making the change often very difficult, if not impossible, to detect. Nervousness or biliousness, by variously affecting the sight of the observer, may also render him unable with certainty to determine the precise moment when he ought to "turn down"; and there is a marked difference in the facility of observation noticeable between a blow taking place in daylight and one at night.

2nd. The Appearance of the Flame as Examined by means of the Spectroscope.

It was important, first, to note if any of the lines belonging to the Bessemer flame were to be found in the flame given off from the coke fire used to heat up the converter. Several examinations were made; the result of these was that, besides the invariable yellow bright line, the red line, and the two bright green lines next the yellow, were occasionally to be seen. Owing, however, to the want of brilliancy of this flame, the spectrum which it gave was very faint, and, at times, almost invisible.

On first turning up the vessel, and for about four minutes thereafter, the spectroscope showed only a continuous band of light, with the colours rather hazy, and so much blended with one another as to make it impossible to mark the junctions of the different fields.

In from four to six minutes, flashes of the yellow line became visible (corresponding to the appearance of tongues of a bright flame, shooting up in the centre of the dull red one issuing from the mouth of the converter); and in one or two minutes after its first appearance, this line became quite steady, and did not disappear even at the end of the blow. Simultaneous with the steadying of the yellow line, the red, yellow, and green fields became clear and well-defined bands of bright colour.

In half a minute to a minute later, a bright green line appeared near the yellow, following which, in scarcely ever more than half a minute, a red line appeared, equidistant from the yellow (of course on the opposite side). These two generally became steady together (having first appeared in intermittent flashes) in about half a minute after both were visible. With the steadying of these two lines at once, a second green line (bright, and about the centre of the green field) became visible, wavering a little at first. About a quarter of a minute served generally to steady it, although sometimes it was a minute and a half from the appearance of the first green line till the second green line with the red became steady.

In one or two minutes, a third green line, nearer the blue field, came into view, and in about one minute was steady. When the red appeared with the first green line, the second and third green lines generally appeared together; but when the red appeared with the second green line, the third green was accompanied by a blue bright line near the green field. In about ten minutes after turning up the converter, the flame attained its maximum size and intensity of light, when a second and third bright line became visible in the blue field. Very often these were only intermittent and very faint; but with "hot metal," and a bright flame, they were pretty steady and distinct, and were broader than those in the yellow, green, and red fields.

Occasionally, for about two or three minutes before the close of the blow, a bright line was seen in the purple field, pretty far to the right of the spectrum; sometimes this only flashed brightly, but on a few occasions it was clearly seen, though faint.

With a very bright flame, several dark lines were seen, but, for want of definiteness, it was impossible to say whether they were not due to the contrast afforded by the brilliancy of the bright ones beside which they appeared. A narrow dark line was seen on each side of the red line, and a broad dark band dividing the yellow from the green; then one between each green line, and two in the blue field, between the three blue lines. But these were only seen with an exceptionally bright flame, and, therefore, are not of much importance.

All the bright lines visible remained steady for several minutes before the close of the blow, affording an excellent opportunity for their examination; but, at the last, all (with the exception of the yellow) faded in less than thirty seconds. The purple line disappeared first (when ever it happened to be visible), then the three blue lines, in the inverted order of their appearance, then the third green, after which the second, then the red, and last of all the first green, when the blast was shut off.

The green and the red lines, from their distinctness, afforded the best point for a determination of the process; and these were so constant, that a sure indication could always be given by any of them, if it were made the index by which to determine the period of blowing.

Very often, on adding the charge of spiegeleisen, a large and very brilliant flame rushed out of the converter for some minutes, and on examining it, the red, yellow, three green, and a very brilliant purple line were seen, but no blue.

3rd. Some Experiments with Coloured Glasses on the Flame.

I shall now proceed to describe some experiments made with coloured glasses on the Bessemer flame. I may mention that what led to them was my brother being compelled to get very dark spectacles to protect his eyes, which were not very strong, from the intensity of the light of the flame. The first pair made completely overcame the brilliancy of the flame, without imparting any colour to it; but, on ordering a second pair, they showed so much colour as to render them useless. On appealing to the workman who had made them, he found that no note had been kept of the kinds of glasses which had been used in the first pair; and, although several attempts were made to repeat them, the second pair sent was the best he could accomplish, and they had appeared colourless to sunlight. The thought then occurred, that, as the brilliancy of the flame varies considerably during its existence, a variation in the amount of transmitted light might be found to affect, in proportionate degree, the power of some coloured glasses to absorb other colours in combination with them, and that a combination of colours might be found to give, with a small quantity of transmitted light, a distinct colour, which could be quite absorbed when a larger quantity of light was passed through the same glasses.

Another, and perhaps the most important, consideration which led to the following experiments, was that the flame itself has a varying chemical composition as the silicon, manganese, carbon, and iron become successively attacked, and that the temperature of the flame at these various stages must necessarily be altered, giving rise, of course, to various colours, or shades of colour, in the flame. If, therefore, a combination of coloured glasses could be found which would absorb the colour due to the flame at a particular temperature, it seemed clear that a change of temperature would become immediately visible, on account of an accession or diminution of colour to the flame as thus observed. It is probable, too, that the colour possessed by the flame at its different stages is due to the various elements which are at these periods

being volatilised, but the spectroscope does not throw much light on this supposition.

The first combination of coloured glasses which I have noted are a

Ruby and { It was found that these colours mutually
Emerald. { destroyed each other. The Bessemer flame,
when viewed through them, appeared white,
and without brilliancy:

Ultramarine blue, { This combination gave the same effect
Dark yellow. { as above.

With a combination consisting of—

Ultramarine blue, { The flame appeared of an emerald
Dark yellow, { colour, but was dark and without
Ultramarine blue, { brilliancy.
Emerald.

In the next experiments, the dark yellow and one blue were replaced by a light yellow and neutral tint, thus:—

Ultramarine blue, { The appearance of the flame in this
Light yellow, { case was similar in colour to that
Neutral-tint, { afforded by the above combination, but
Emerald. { appeared of considerable brightness.

In the next experiments, the light yellow and neutral tint were replaced by a dark yellow and red, respectively, thus:—

Ultramarine blue, { The flame at first was dimly seen, and
Dark yellow, { without colour; when it reached its
Ruby, { maximum brilliancy, it still appeared
Emerald. { white through this combination.

With these five combinations, the appearance of the sun, as seen through each of them, was similar in character to that of the flame, but more powerful in degree.

In the subsequent experiments, the combination was as follows:—

Ultramarine blue, { The flame appeared at first of a ruby-
Dark yellow, { red colour, increasing in size and in-
Neutral tint, { tensity as the blow progressed, the
Ultramarine blue. { edges of the flame acquiring a lighter
shade of red, but the colour was too
strong to admit of the changes being
easily determined. Sunlight, through
this combination, was slightly yellow.

In the succeeding experiments, one of the blue glasses was replaced by a light yellow, giving a combination of—

Ultramarine blue, { The flame appeared at first of a
Dark yellow, { yellowish red colour; as the blow
Neutral tint, { progressed this colour became whiter,
Light yellow. { with flashes of redder flame occasion-
ally through it. At the flame's maxi-
mum brilliancy, the edges assumed a
light-red colour (nearly white), while at
the root and centre of the flame the
colour was of a darker yellowish red.
When the flame dropped (at the end of
the blow), it returned to a yellowish
red colour, somewhat similar in appear-
ance to the effect produced at the be-
ginning of the blow. Sunlight appeared
slightly yellow.

It will be observed that this combination gave nearly the desired effect—viz., a variation of depth of colour due to the differences of temperature or brilliancy of the flame at its different stages of progression. The yellowish tint, however, always present, showed a defect in this combination, to overcome which further trials were made. Among other devices, the light yellow was omitted, and the flame was observed with—

Ultramarine blue, { The flame appeared still red, and with
Dark yellow, { the yellowish tint, though in such
Neutral tint. { small degree as to show that the
desired result was not far off. Sun-
light appeared dim, and slightly yellow.

In the concluding experiments, the neutral tint was replaced by a blue glass, with the object of ascertaining whether the yellow colour could be corrected by the omission of the red or the blue component of the neutral tint, thus:—

Ultramarine blue, { This combination was perfectly suc-
Dark yellow, { cessful, the lingering trace of yellow
Ultramarine blue, { being removed.

I shall now describe more fully the appearance of the flame through it.

For the first four or five minutes all is dark; the chimney is invisible; nothing but the mouth of the converter can be made out, which appears slightly red, the sparks coming from it being scarcely visible. As the blow progresses, the flame, still red in colour, increases in size and luminosity, while the outline of the vessel becomes visible. In about twelve to fifteen minutes the flame begins to lose its colour, becoming violently agitated, flashes of a lighter and brighter flame shooting up occasionally.

In about fifteen minutes a purple tint becomes visible round the mouth of the vessel, the flame gradually acquiring a white colour towards the edges.

When the flame has reached its maximum brilliancy it appears bright and nearly white, with the edges purple. The red colour thereafter begins to re-appear at the mouth of the vessel and centre of white flame, gradually extending until the whole flame appears of a light red colour.

And with the peculiar hollow sound heard in the vessel always preceding the drop, the centre of the flame begins to acquire a deeper colour; this quickly extends and deepens. Within a minute or so of the drop the whole flame becomes crimson, and losing its brilliancy, and within half a minute, it suddenly goes back to very nearly the red colour it had at starting.

This combination of glasses is now in daily use in the Atlas Works, its indications being so marked and unmistakable as to render its use safe in the most inexperienced hands. This little instrument or "Chromopurometer," as it is proposed to call it, is arranged as follows:—

One of the blue glasses and the dark yellow one are fixed in a rectangular frame, carrying at its foot a hinge to which the thin frame holding the other blue glass is attached, and at its top a spring catch to hold this smaller frame when in its shut position, and also a pin and set screw for attaching the whole instrument to the hat of the observer so as to place it before his eyes.

The object of having the glasses thus divided is to give facility for the observation of the flame through the combination of three, while during the pouring two being sufficient, the third one is allowed to hang down, when it serves to protect the lips from the great heat of the ladle and liquid steel.

In conclusion, I think it is probable that, by carefully noting by means of coloured glasses such as that described, the amount of light (as determined by the shade of colour visible) emitted by flames of known temperature, a scale might be formed which would enable us approximately to measure the temperature not only of the flame of the Bessemer Converter, but also that of many flames which have hitherto been considered beyond reach of our ordinary methods of measurement.

Toluol.—(*Comptes Rendus*, 1869, No. 10).—M. A. Rosenstiehl has made a series of experiments with the view to solve the question whether the toluol we are acquainted with is a mixture of two isomeric hydrocarbons, which would yield two toluidines, or whether toluol is a peculiar principle which on being acted upon by nitric acid is converted into two different nitro-compounds. From seven samples of toluol prepared by as many different processes, the author has obtained the same result, to wit, a crystallised nitro-toluol, corresponding to toluidine, and another liquid—nitro-toluol—corresponding to the pseudo toluidine. By the reduction of divers nitro-toluoils, prepared by various methods, the author obtained a large quantity of alkaloids which have been submitted to analysis; he found also (1) there are always two nitro-toluoils formed, which, by reduction, yield two toluidines; (2) the proportion of the two nitro substances is not constantly the same; he never obtained more than 66 per cent and never less than 33 per cent of toluidine from 100 parts of crystallised nitro-toluol.

ON THE WASHING OF PRECIPITATES.*

By Professor R. BUNSEN.

(Continued from p. 162).

IN washing, by means of decantation, in the ordinary manner, the amounts of chromium sesquioxide found were as follows:—

- | | | | |
|------|---------|------------------------|-----------------------------------|
| II. | 0.2458, | after 5 decantations, | washed to the 50,000th part. |
| III. | 0.2452, | after 7 decantations, | washed to the 200,000th part. |
| IV. | 0.2443, | after 10 decantations, | washed to the 100,000,000th part. |

0.2451 mean.

By the use of the pump:—

- | | | |
|-------|---------|-----------------------------|
| V. | 0.2435, | after 5 additions of water. |
| VI. | 0.2434, | " 4 " " |
| VII. | 0.2432, | " 3 " " |
| VIII. | 0.2435, | " 2 " " |
| IX. | 0.2439, | " 1 addition of water. |
| X. | 0.2439, | " 1 " " |

0.2436 mean.

Hence the probable amount of chromium sesquioxide contained in the solution, according to the experiments with the pump, was 0.2436 grm.; according to the old method of decantation it was somewhat higher, namely 0.2451 grm. This excess of 1.5 milligramme shows that the adhesion of the soluble matters to the precipitate and to the filter is, in consequence of the greater pressure, more easily overcome in the new method than in the customary process; it follows, therefore, that we can obtain a more complete washing by the new method than by the old. The old process of decantation required 108 minutes and 1050 c.c. of water to effect a washing to the 50,000th part; the new, on the contrary, only 12 to 14 minutes, and not more than 39 to 41 c.c. of wash-water. If a precipitate be heated in a platinum crucible immediately after filtration by the older process, a portion will inevitably be projected out of the crucible. Hitherto, therefore, it has been necessary to dry the filter and precipitate before ignition. Now to dry a quantity of hydrated chromium sesquioxide containing 0.2436 grm. Cr_2O_3 in a water-bath at 100°C . requires at least 5 hours; and, moreover, bringing the dried precipitate into the crucible, burning the filter, and gradually igniting the mass is in the highest degree tedious and troublesome. All this expenditure of time and labour may be saved by employing the new method. By its means a precipitate is as completely dried upon the filter in from 1 to 5 minutes as if it had been exposed from 5 to 8 hours in a drying-chamber; and it can immediately, filter and all, be thrown into a platinum or porcelain crucible and ignited without the slightest fear of its spurting. By operating in the following manner the filter burns quietly without flame or smoke; this phenomenon, although remarkable, easily admits of an explanation. The portion of filter-paper free from precipitate is tightly wrapped round the remainder of the filter in such a manner that the precipitate is enveloped in from four to six folds of clean paper. The whole is then dropped into the platinum or porcelain crucible lying obliquely upon a triangle over the lamp, and pushed down against its sides with the finger. The cover is then supported against the mouth of the crucible in the ordinary way, and the ignition commenced by heating the portion of the crucible in contact with the cover. When the

flame has the proper size and position, the filter carbonises quietly without any appearance of flame or considerable amount of smoke. When the carbonisation proceeds too slowly, the flame is moved a little towards the bottom of the crucible. After some time the precipitate appears to be surrounded only by an extremely thin envelope of carbon, possessing exactly the form (of course diminished in size) of the original filter; the flame is then increased, and the crucible maintained at a bright-red heat until the carbon contained in this envelope is consumed. The combustion proceeds so quietly that the resulting ash surrounding the precipitate possesses, even to the smallest fold, the exact form of the original filter. If the ash shows here and there a dark colour, it is simply necessary to heat the crucible over the blowpipe for a few minutes to effect the complete removal of the trace of carbon. This method of burning a filter is extremely convenient and accurate; it is only necessary to give a little attention at first to the slow carbonisation of the paper, after which the further progress of the operation may be left to itself.

Gelatinous, finely divided, granular, and crystalline precipitates, such as alumina, calcium oxalate, barium sulphate, silica, magnesium ammonium phosphate, &c., may with equal facility be treated in this manner; so that even in this particular the work, in comparison with the method generally adopted, is considerably shortened and simplified.

From the above experiments it appears that the time necessary to filter and dry a quantity of chromium sesquioxide, hitherto requiring about 7 hours, is reduced by the new method to 13 minutes. This saving of time is, moreover, proportionately greater in the case of precipitates more easily filtered than hydrated chromium sesquioxide. Particularly is this so in separating a finely suspended precipitate from a large volume of water. Under these circumstances the clear fluid runs through the filter in a continuous stream, so rapidly that it is scarcely possible to maintain the supply; the entire operation, in fact, requires scarcely more time than that necessary to pour a liquid from one vessel to another. Filtration, therefore, may be effected as quickly through the smallest as through the largest filter. Moreover, the exceedingly small amount of water required to wash a precipitate completely renders unnecessary the tedious evaporations which, by the older method, are almost inevitable when the filtrate is needed for a further separation. Thus the introduction of impurities from the action of the liquid upon the dish in the course of evaporation is prevented; and also the loss due to the slight solubility of the greater number of precipitates in the wash-water is reduced to a minimum. Supposing we had to analyse an alkaline chromate in which the quantity of chromic acid is equivalent to 0.2436 grm. chromic sesquioxide, as in the above-described experiments, then to determine the proportion of alkali we should, by using the older method, require the preliminary evaporation of about 1050 c.c. of liquid; by the new method the evaporation of 40 c.c. only is necessary. Now by employing the best form of water-bath, *i. e.* one possessing a constant water-level, such as is used in my laboratory, it is possible, under favourable circumstances, to evaporate in a porcelain dish 1 c.c. of water in 27 seconds. Consequently the evaporation of the filtrate obtained by the older method would occupy about 8 hours, whilst by the new 18 minutes only are required. The total length of time needed to filter the chromium sesquioxide, wash and dry the precipitate, and evaporate the filtrate is reduced, therefore, from 14 or 15 hours to about 32 minutes.

The experience I have subsequently gained in my laboratory, where the method has been in general use for the last nine months, fully confirms the above results. It has shown that, on the average, three or four analyses can now be made in the time formerly demanded by a single one.

Another and an inestimable advantage springs from the

* We are kindly permitted by the proprietors of the *Philosophical Magazine* to copy these portions of Professor Bunsen's paper from their number for January, 1869, where the complete paper may be found.

peculiar condition of a precipitate filtered by this method. It not unfrequently happens, even in the hands of experienced manipulators, in consequence of the agitation it is necessary to give to the contents of the filter to effect their complete washing, that the surface of the filter becomes injured and torn, so that the precipitate becomes mixed with filaments of paper; this is particularly the case in using hot water. Supposing the precipitate to consist of mixed hydrates of the sesquioxides (for example, iron and alumina), it will be found, on redissolving in an acid, that the filaments, like tartaric acid, prevent the complete separation of these substances by subsequent precipitation; thus the alumina will contain iron, and on precipitation by means of ammonium sulphide will be coloured black. On the other hand, by employing the new method the precipitate coheres so firmly that the introduction of this source of error is impossible, even by using common grey filter-paper. The most

pressure, the precipitate only occupying one-third to one-sixth of its bulk under ordinary circumstances, a filter of one-third to one-sixth of the size usually employed may be taken, and thus the amount of ash proportionately lessened.

As the water air-pump suffers no injury from the presence of corrosive vapours or gases, we can equally well employ it to filter liquids containing nitrous acid, sulphurous acid, fuming nitric acid, chlorine, bromine, volatile chlorides, &c. In such cases I use a peculiar filtering arrangement, consisting of a cylindrical glass vessel, the lower end of which is drawn out before the blowpipe to the form shown in fig. 5; in this drawn-out portion a thin plate, 1 or 2 m.m. in thickness, of artificial pumice, such as is used by polishers, is packed water-tight by means of asbestos. This apparatus is arranged for the purpose required exactly as the funnel in the method of filtration by pressure above described. In order to have a number of these filters in readiness, a pumice-stone cylinder of the required diameter is turned in a lathe, and then the thin plates sawn off by means of a small hand-saw in the small wooden support shown in fig. 6. The upper surfaces of the plates may afterwards be rendered perfectly even by a coarse file.

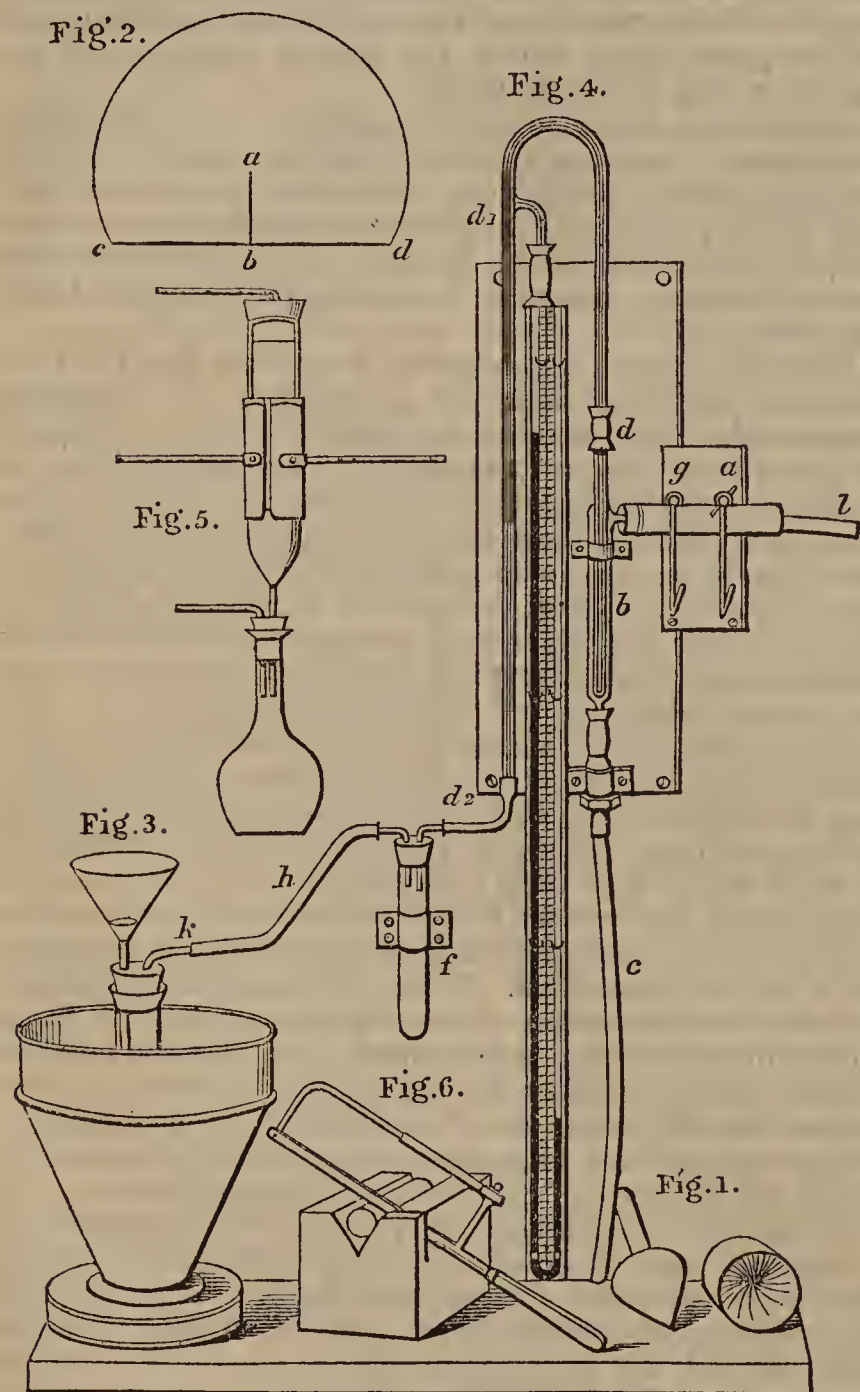
By the aid of these pumice-stone filters many chemical products may be made, the preparation of which has hitherto been almost impossible. For the sake of example, I take the preparation of pure dry chromic anhydride; in an hour it is easily possible to filter, wash, and dry crystals of this substance an inch in length. A solution of 2 parts of potassium dichromate in 20 parts of water mixed with 10 parts of concentrated sulphuric acid, deposits, after standing about 24 hours, numerous brilliant needles of chromic anhydride. These may be drained from adhering mother-liquor upon the pumice filter by means of the pump, and in a few minutes completely washed by a small quantity of fuming nitric acid free from nitrous acid. A covering of tolerably strong sheet copper provided with two arms, as shown in fig. 5, is then placed round the tube; by hanging lamps upon the arms the tube may be readily heated to about 60° or 80° C.; and by connecting a chloride-of-calcium tube with the upper end of the glass vessel, a current of dry air may be drawn through the apparatus by means of the pump, and thus, in a comparatively short time, large and brilliant crystals of chromic anhydride, perfectly dry and free from all impurity, may be easily obtained.

A single pump of the above description costs, including the leaden piping, about 8 thalers (24 shillings); and experience has shown that five or six are amply sufficient for a laboratory of fifty or sixty students. The apparatus, as may readily be seen, can be applied in the operation of evaporating *in vacuo*.

I believe that the above-described water air-pump will soon become an indispensable piece of apparatus in chemical laboratories. It not only serves as the most convenient method of producing the differences in pressure required to accelerate the process of filtration, and of obtaining the necessary vacuum for evaporation; it is equally adapted for purposes to which neither the mercury nor the ordinary pumps are in any way applicable. By its aid it is possible to calibrate a thermometer with the greatest accuracy, and to estimate the vapour-tension of such corrosive bodies as bromine, chromyl dichloride, &c. by the simplest method possible, in which the necessary operations require scarcely more time than an ordinary determination of a boiling-point.

I purpose returning to these applications of the instrument in a future communication.

Artificial Sulphate of Baryta.—(*Boston Journal of Chemistry.*)—This, applied to glass by means of silicate of potash, imparts to it a milk-white colour of great beauty; in a few days the silica is intimately combined with it, and the colour resists washing with warm water. By the action of strong heat, this siliceous varnish is transformed into a white enamel. Blue ultramarine, oxide of chromium, and pulverised coloured enamels may be likewise applied.



gelatinous precipitates, as hydrated ferric oxide, alumina, &c., adhere to the filter in a thin coherent layer, and may be removed, piece after piece, so completely that the paper remains perfectly clean and white. The advantage thus gained, where it is necessary to transfer mixed precipitates to another vessel in order to effect their subsequent separation, is evident.

The filter-pump, moreover, is exceedingly serviceable in separating precipitates or crystals from syrupy mother-liquors. Thus honey-sugar may be so completely separated from the thick viscid liquid in which it forms, by a filter of coarse grey paper, that it remains only slightly coloured, and by a single crystallisation from alcohol may be obtained in small white shining needles. And since the bulk of the moist precipitates, particularly that of the more gelatinous, is so much diminished under the high

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, Tuesday, March 30th, 1869.

Dr. WARREN DE LA RUE, F.R.S., President, in the Chair.

THE business of the evening commenced with the reading of the financial statement by the Treasurer, which had been audited by Mr. Tuson and Mr. Robert Warington.

The PRESIDENT called the attention of the Society to a circular from Yale College, warning the scientific public against an impostor who was ostensibly collecting minerals and was receiving monies in the name of some of the principals of the college. He then proceeded to read the address, which gave a very clear account of the year's progress in chemistry, and referred to some of the leading investigations in the various departments of chemical science.

Mr. HEISCH, in proposing a vote of thanks to the President for his address, spoke in laudatory terms of the way in which Dr. De La Rue had filled the Presidential chair, and proposed that the address be printed, and circulated amongst the fellows of the society.

Professor WANKLYN seconded the vote of thanks, and spoke of the great difficulties with which the President had had to deal at different times during his presidency.

Dr. ODLING could not recall a president who had devoted so much time and attention to his duties as Dr. De La Rue. He had also achieved some difficult negotiations with a success which showed, in the highest degree, the esteem in which he was held, and the position which the Society had attained.

The proposal was carried by acclamation.

The meeting then proceeded to the election of officers, Messrs. Basset and Warington acting as scrutators. The following are the names of the officers for the present year:—

President.—A. W. Williamson, Ph.D., F.R.S.

Vice-Presidents, who have filled the office of President.—Sir B. C. Brodie, F.R.S.; Warren De La Rue, Ph.D., F.R.S.; Thomas Graham, D.C.L., F.R.S.; A. W. Hofmann, D.C.L., F.R.S.; W. A. Miller, M.D., D.C.L., F.R.S.; Lyon Playfair, Ph.D., C.B., F.R.S.; Colonel P. Yorke, F.R.S.

Vice-Presidents.—J. H. Gilbert, Ph.D., F.R.S.; J. H. Gladstone, Ph.D., F.R.S.; H. M. Noad, Ph.D., F.R.S.; W. Odling, M.B., F.R.S.; T. Redwood, Ph.D.; John Stenhouse, LL.D., F.R.S.

Secretaries.—A. Vernon Harcourt, M.A., F.R.S.; W. H. Perkin, F.R.S.

Foreign Secretary.—H. Müller, Ph.D., F.R.S.

Treasurer.—F. A. Abel, F.R.S.

Other Members of Council.—E. Atkinson, Ph.D.; J. Lothian Bell; E. T. Chapman; W. Crookes, F.R.S.; David Forbes, F.R.S.; D. Hanbury, F.R.S.; A. Matthiessen, Ph.D., F.R.S.; E. J. Mills; J. Prestwich, F.R.S.; Maxwell Simpson, Ph.D., F.R.S.; A. Voelcker, Ph.D.; C. Greville Williams, F.R.S.

Mr. FIELD proposed a vote of thanks to the officers and council for their efficient services during the past year, and associated with the vote the names of Dr. Redwood and Dr. Odling. For twelve years Dr. Odling had, with hardly a single exception, occupied the Secretary's chair at every meeting of the Society; and they could not allow him to conclude his secretaryship without thanking him for his kindness and courtesy, as well as for his successful endeavours to promote the welfare of the Society.

Mr. TUSON, in seconding the vote, also spoke in appropriate terms of the valuable services of Dr. Odling and Dr. Redwood.

The PRESIDENT said that the Secretary was the most

active agent of the Society. Without active secretaries, the meetings would sometimes pass over without that intellectual food from which they derived so much benefit.

The vote was carried amidst great applause.

Dr. ODLING thanked the Society for the kind manner in which they had expressed their satisfaction with the services of himself and Dr. Redwood, and referred to some of the changes which had taken place in connection with the Society during the thirteen years he had been Secretary, and also to the pleasure he had derived from being on terms of close acquaintance with the distinguished men who had filled the chair during his term of office.

A vote of thanks to the Scrutators brought the proceedings to a close.

Thursday, April 1st, 1869.

Dr. A. W. WILLIAMSON, F.R.S., President, in the Chair.

THE list of presents to the Society was read, and a vote of thanks passed to the donors.

The following certificates were read:—

For the first time—E. Meusel, University College; A. W. Reinold, Merton College, Oxford; J. M. Muir, Shortland, Thames Gold Field, New Zealand.

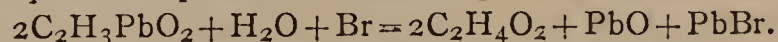
For the second time—J. T. Bottomly, M.A., King's College, London; F. Braby, Mount Henley, Sydenham Hill.

For the third time—W. H. Deering, 12, Surrey Square, Old Kent Road, S.E.

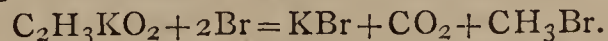
The last-mentioned gentleman was then balloted for and declared duly elected.

A paper by Messrs. E. T. Chapman and Miles H. Smith "*On some Decompositions of the Acids of the Acetic Series*" was then read. The following is an abstract:—

Action of Bromine on Acetate of Lead.—On adding bromine to an aqueous solution of acetate of lead, the authors found that a brown precipitate, consisting of peroxide of lead, was formed. On being warmed, the formation of the precipitate proceeded until 1 eq. of bromine had been added to 2 eqs. of acetate of lead. The following equation represents the decomposition:—



Action of Bromine on Acetate of Potash.—Two eqs. of bromine and one eq. of acetate of potash, and water, were sealed in a digestion tube for eleven hours. On cooling and opening the tube, CO₂ escaped, from which the mixture was freed by dilute caustic potash. The following change occurred:—



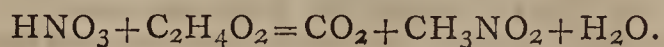
Action of Chlorine on Acetate of Potash in Aqueous Solution.—The action is strictly analogous to that of bromine. Bichloride of methylene is amongst the products of this reaction; and the authors think that, under appropriate circumstances, it would furnish a convenient source of this substance.

Action of Bromine on Valerianate of Soda in Aqueous Solution.—The products of this reaction are carbonic acid and bromide of butyl, more or less brominated. By fractional distillation of the liquid products, a body, having about the boiling point of bi-bromide of butylene, was obtained.

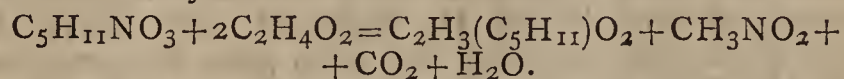
Iodine was found to have little action on the alkaline salts of the fatty acids.

Nitrate of Amyl and Acetic Acid.—On adding nitrate of amyl drop by drop to a warm mixture of twenty parts of glacial acetic acid and one of concentrated sulphuric acid, gases are evolved which consist of carbonic acid, a little nitrogen, a trace of bin oxide of nitrogen, and an inflammable gas. The latter is soluble in solution of protochloride of iron, and proved to be nitrite of methyl. The liquid products of the reaction were acetate of amyl, with traces of acetate of methyl. Leaving out the amyl

and the sulphuric acid, which takes no part in this or the following reaction, though causing them to take place, the reaction was as follows:—



With the amyl—

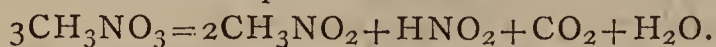


The acetate of methyl is supposed to owe its origin to a secondary reaction between the nascent nitrite of methyl and the excess of glacial acetic acid.

Nitrate of Butyl and Glacial Acetic Acid.—The action is precisely similar to the above, butyl being substituted for amyl.

Nitrate of Ethyl and Glacial Acetic Acid differ only from the above, in that the nitrate of ethyl decomposes, to some extent, by the heat of the reaction, and some of the products of the decomposition are obtained with the others.

Nitrate of Methyl and Glacial Acetic Acid.—The methyl of the nitrate of methyl is oxidised, and not the acetic acid. The authors express the reaction as follows:—



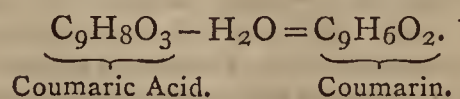
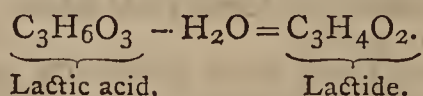
Action of Formic Acid on Nitrate of Amyl.—In the presence of sulphuric acid, these bodies give rise to formate of amyl, protoxide of nitrogen, carbonic acid, and water.

Mr. PERKIN remarked that some time back Mr. Duppa told him that he had succeeded in obtaining the chlorides of the radicals from acetates and salts of the other acids. In the case of acetic acid, he obtained chloride of methyl; and in the case of succinic acid, he obtained chloride of ethyl. He (Mr. Perkin) made an examination of the chloride of ethyl, and found that it produced the normal hydride, and behaved just as the normal chloride of ethyl.

The PRESIDENT asked Mr. Chapman under what conditions he got the chloride of methylene by the action of chlorine upon potassic acetate, whether with the presence of water or not?

Mr. CHAPMAN replied that all the decompositions occurred in the presence of water, with the exception of that in the case of glacial acetic acid. When the liquid was kept warm, and the chlorine passed into it pretty rapidly, being occasionally neutralised with potash, a notable quantity of chloride of methylene was formed, but it had to be looked for and condensed with care.

Mr. W. H. PERKIN, F.R.S., then made some remarks in reference to a paper published in the CHEMICAL NEWS* by Fittig, "*On the Constitution of Coumarin and Coumaric Acid.*" Fittig assumed that coumarin was not formed from the hydride of aceto-salicyl, as had been stated, but that it resulted from the previous formation of coumaric acid. Some time since, Bertagnini stated that the hydride of benzoyl, when treated with chloride of acetyl, yielded cinnamic acid; and Fittig supposed that an analogous reaction took place between the hydride of salicyl and acetic anhydride, yielding coumaric acid, which, according to this view, would be oxycinnamic acid; this, by the further action of acetic anhydride, decomposing into coumarin and water. Coumarin would therefore be the anhydride of coumaric acid, standing in the same relation to coumaric acid as lactide did to lactic acid, thus:—



But the question was whether coumarin had the properties of an anhydride at all. It was formed in the plant, in the presence of water; and it might be crystal-

lised from water any number of times without being changed. If boiled in strong potash, a saline compound of coumarin was obtained; but directly an acid was added it separated unchanged. On adding nitrate of silver to a well-saturated solution of coumarin in soda, a yellow precipitate was produced, which, on analysis, gave the formula of coumarin, *plus* oxide of silver, $\text{C}_9\text{H}_6\text{O}_2\text{Ag}_2\text{O}$. If it were an anhydride, it would yield, with ammonia, an amide; but it did not do so, and he thought it was very evident that it was not an anhydride, as Fittig supposed it to be. In fact, it was not an easy matter to produce coumaric acid from coumarin, a boiling supersaturated solution of caustic alkali being required.

The PRESIDENT thought that Mr. Perkin's statements decided very clearly the point which had been raised by M. Fittig; but to complete some of his statements, he would like to ask him if he had recognised the properties referred to in the artificial as well as in the ordinary coumarin?

Mr. PERKIN said that not only the artificial coumarin, but also the homologues formed compounds with caustic soda; and, in the case of the homologues, as the soda concentrated on boiling, the new compound separated as an oily layer, which, on cooling, became a sticky mass.

The PRESIDENT remarked that it was not conceivable that an anhydrous acid on boiling with water and an alkali should remain as an anhydrous acid capable of falling down as such upon the addition of an acid. He thought Mr. Perkin's evidence was quite conclusive.

Mr. PERKIN, on trying Bertagnini's experiment with the hydride of benzoyl and chloride of acetyl, had not yet succeeded in obtaining cinnamic acid. He did not know whether any gentleman present had succeeded in obtaining it. He intended to repeat the experiment, and hoped to be more fortunate.

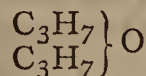
The PRESIDENT thought the absence of the action of ammonia on coumarin very conclusive that it could not be an anhydrous acid. He thanked Mr. Perkin for his communication, and announced that the next meeting would be held on the 15th inst.

FRENCH ACADEMY OF SCIENCES.

Monday, March 22nd, 1869.

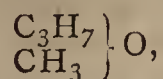
AMONG the papers read we notice and briefly abstract the following:—"*On the Luminosity of Geissler Tubes by Friction.*" M. ALVERGNAT calls attention to the fact, that by simply rubbing one of the aforesaid tubes with the dry hand or a piece of silk, it exhibits the same phenomena of luminosity as if induced by electricity; the phosphorescence is, however, weak, but may be increased when within the tube are deposited substances which may become phosphorescent under the influence of electricity; when a tube so arranged is quickly rubbed it becomes within a few moments sufficiently luminous to serve as a faint light to see in a dark room.

Professor Dr. G. CHANCEL read a paper "*On the Ethers of the Propylic Alcohol derived from Fermentation.*" He begins with a statement that his researches on this subject are not yet sufficiently advanced to enable him to give complete details; propylic ether, or oxide of propyl—

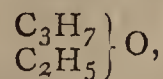


is obtained by the action of iodide of propyl on the propylate of sodium. The oxide of propyl boils at about 86°C ., and is a liquid exhibiting a high refractive power, slightly soluble in water. When the iodides of methyl, ethyl, and amyl, are suffered to act upon propylic alcohol in the presence of potassa, compound ethers are obtained,

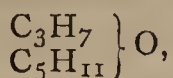
e.g., propyl-methylic ether, or oxide of propyl and methyl—



which boils at between 49° and 52° C.; propyl ethylic ether, or oxide of propyl and ethyl—



which distils over at about 86° C.; propyl amylic ether, or oxide of propyl and amyl—



which boils between 125° and 130° C. All these liquids have a density varying between 0.75 and 0.80, and exhibit a peculiar ethereal odour, as of ordinary ether mixed with some strange odoriferous principle.

M. E. J. MAUMENE presented a note "*On the Action of Corrosive Sublimate on Biniodide of Ethylen.*" The author first reminds, that some years ago he called attention to the fact that Berzelius and other authors had not paid proper attention to the reactions which in this instance take place, and Maumené comes to the conclusion that Berzelius had not even had prepared biniodide of ethylene, but mistaken iodoform in its stead. Sérullas, Mitscherlich, Bouchardat, and others, are then criticised, and the author next goes on with a series of theoretical reasonings not directly supported by experiments, but entirely founded on algebraico-chemical formulæ and reasoning; by these means he proves that, not as was stated by Berzelius, iodine of carbon is the result of the reaction, but that either a chloriodide of ethyl or a chloride of ethyl is formed. The learned author ends his paper with this dictum: All chemical actions can be beforehand proved by theory; all formulæ which do not agree with it, will be rejected by experiments.

Monday, March 29th, 1869.

This meeting was one of very little interest for the scientific public generally; being chiefly occupied by the reading of correspondence relating rather to history.

The Rev. Father SECCHI, S.J., made an interesting communication in reference to the spectroscopical research made by him of the light emitted from the planet Uranus. This light, it appears, differs from that of the rest of the planets belonging to our solar system. The spectrum shown by the light of this planet, exhibits broad absorption lines; so that the yellow colour is almost entirely wanting—absorbed. While it is clear that the light emitted by this planet is reflected light from our sun, it is evident that the surface of the planet modifies that light in the same manner as do coloured bodies.

The Rev. Father also communicated, that the spectrum of R. Gemini, a so-called variable star, clearly exhibits, when at its greatest brightness, the lines due to hydrogen, magnesium, and sodium.

NOTICES OF BOOKS.

Town Life among the Poorest. By JOHN EDWARD MORGAN, M.A., M.D. London: Longmans, Green, & Co.

Dr. MORGAN read a paper on the dwellings of the poor in towns, at a meeting of the British Medical Association, Oxford, last August, and the pamphlet before us is a reprint of this matter. The author remarks that the housing of the poor, while beset with great difficulties, is most intimately connected with the future prosperity of the great mass of the people. In all our great cities, there are unhealthy quarters where the death rate is exceptionally high, and the reason of this, after careful inspection

of many such places, Dr MORGAN believes is to be found in this statement. Bad air, or too little of it, kills the people.

Men will grow robust and vigorous, the author remarks, on very poor food, in very dirty cabins, and in very sorry attire, provided they enjoy a pure and bracing atmosphere, and the great physical development of the nations of the Hebrides and the western highlands of Scotland is cited as an example. In striking contrast to this, we find that in the Isle of St. Kilda, a small island, numbering about eighty inhabitants, three out of every five infants born alive are carried off a few days after birth by a convulsive affection allied to tetanus, the difference being apparently due to the huts having no smoke-hole in the thatch, and being rendered nearly impervious to air by double walls filled in with peat and sods, the object of which is to prevent the escape of smoke, and in due time the soot is collected and used as manure. Space will not permit us to deal with the details of the subject, but the data appear to be carefully collected, and we believe that those interested in the subject will find this little work worthy of their attention.

CORRESPONDENCE.

THE CHEMISTRY OF SUGAR REFINING.

To the Editor of the Chemical News.

SIR,—I was led to infer from the tenor of Dr. Wallace's communications, that he supposed the fact that "weak acids invert cane sugar" was insufficiently known, or he would not have repeated it so frequently. The *reductio ad absurdum* of his concluding remarks on this subject is rather an old ruse, and quite unworthy of him.

My remarks on the calcic carbonate with which sugar refiners of this country load the carbon surface of their bone-black, had reference to that which is derived from impurities in the crude sugar, and not that found in new bone-black. Dr. Wallace admits in his papers, that the amount of calcic carbonate existing in bone-black as in use in our refineries is a variable quantity, sometimes in excess, at others deficient; would it not, therefore, be preferable to get rid of it entirely (as it is not an *essential* constituent of bone-black, as far as the sugar refiners' use of it is concerned, as the Dr. would have us believe), either by the dry hydrochloric acid gas process, or by "others of a similar nature," if such can be found, and neutralise the acid of the crude sugar before submitting it to the action of the bone-black in the manner, as I have already said, which is in practice in other countries? Or the syrup of the crude sugar might advantageously be filtered through calcic carbonate in grains before passing it on to the bone-black filters: thus the complaints of "sour liquors and the occurrence of iron in the syrups" would cease.

I would, in conclusion, remind Dr. Wallace that the use of intemperate terms in a scientific discussion does not tend to bring conviction to the mind.—I am, &c.,

EDWARD BEANES.

Cordwalles, Maidenhead,
April 6th, 1869.

MISCELLANEOUS.

The Royal Polytechnic.—The most striking of the Easter novelties at this institution is the large induction coil, which has been made by Mr. Apps. It is 10 feet long and 2 feet in diameter. The core of soft iron weighs 123 pounds, and consists of wires each 5 feet long and .0625 inches in diameter. The primary coil weighs 145 pounds, and is composed of 3,770 yards of copper wire. The secondary wire is 150 miles in length, and .015 inches in diameter. The galvanic current for the primary coil is

supplied by 40 of Bunsen's cells. It is capable of producing a spark 29 inches long, and the flash will perforate plate-glass 5 inches thick. This huge and powerful coil will not only be valuable to Professor Pepper to illustrate the wonders of electricity to the general public, but we hope it will be used as a means for promoting scientific research.

The Gas Supply of the City of London.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has, in accordance with the provisions of the 71st section of the City of London Gas Act, 1868, reported on the quality of the gas supplied to the City of London during the months of January, February, and March of the present year, from which it appears that the illuminating power of the gas supplied by the several city companies is as follows:—

Illuminating Power in Standard Spermin Candles.

	Maximum.	Minimum.	Average.
City of London Gas Light and Coke Company	16.27	14.03	14.83
The Gas Light and Coke Company	16.28	14.38	15.26
Great Central Gas Consumers' Company	16.85	14.26	14.99

These are the results of examinations of each of the Companies' gas, three times daily, at intervals of not less than an hour, between the hours of five and ten o'clock in the afternoon. As regards the purity of the gas, he reports that ammonia has constantly been present in the gas of the Chartered and the Great Central Companies; but that the gas of all the companies has been always free from sulphuretted hydrogen. The amounts of sulphur present in the gas in other forms has been as follows:—

Grains of Sulphur per 100 cubic feet of Gas.

	Maximum.	Minimum.	Average.
City of London Gas Light and Coke Company	18.92	11.70	15.00
The Gas Light and Coke Company	24.15	15.75	19.49
Great Central Gas Consumers' Company	24.00	7.03	12.28

Report on the Sewage of the City of Melbourne.—Mr. W. Sydney Gibbons has kindly forwarded to us a copy of his report on this subject, from which report we briefly abstract the following:—It appears that as yet the City of Melbourne is not provided with a proper system of underground sewers, but a kind of cesspit filtration, suggested by Dr. Tracy, has been adopted, and Mr. Gibbons was requested to inquire into the efficiency of that system which, briefly described, has the following arrangement:—The water-closet is supplied by Yan Yean service, and by the bath-water of the house to the exclusion of kitchen slops. The cesspit, at a short distance from the closet, is a large stone chamber furnished with an iron grating, and a partition-wall dividing it into two parts except at the bottom. The dejecta are thus comminuted by the force of the stream of water beating against the partition-wall and the grating, so that before they reach the filter, the whole is homogeneous liquid. The filter, at the bottom of which the mixture enters, is a covered pit with an iron grating at a short distance above the bottom and another near the top. Between the two are layers of road-metal, oyster-shells, and a mixture of animal and vegetable charcoal. The author of this report made a very minute inspection of all things connected with this subject, and took at different places in Melbourne, samples of filthy sewage water in open gutters, which samples were analysed; the samples all agreed herein that they contained a large amount of organic matter and solid residue, while foetid exhalations and gases were freely given off; for comparison's sake the Yan Yean water from the main pipes was analysed, and this water found to be clear and sweet; yielded a solid residue of 8.736 grains to the gallon, of which 2.152 grains are organic matter. This water was

free from ammonia and sulphuretted hydrogen; microscopic research of this water, as well as of the sewage water, proved the former to contain only such infusion as may always be met with in fresh sweet natural water, but in the case of sewage, myriads of all kinds of lower animal forms of life such as accompany foul and decaying organic matter were met with. As to the cesspit filtration arrangement, it was fully proved to be chemically inoperative, and mechanically incomplete. The lengthy and copious report, which is chiefly of local interest, proves that the city of Melbourne is sadly behind in proper sanitary arrangements, and deficient in the requisite means to carry off its foul and refuse matter.

CONTEMPORARY SCIENTIFIC PRESS.

AFTER an experiment of more than eighteen months, we have decided to discontinue this department of the journal, and we have made arrangements for giving abstracts of the contents, instead of the titles merely, of all original articles in the leading Foreign Chemical journals. Those articles which are too comprehensive to be condensed will, if they are of sufficient importance, be translated in full, and inserted as soon as possible after their publication abroad. These abstracts will be printed in smaller type, thereby increasing the available size as well as the value of the CHEMICAL NEWS.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Analysis of a Meteorite (Cosmos), known as the meteorite of Wisconsin, U.S. Specific gravity, 7.82; composition in 100 parts:—Iron, 91.03; nickel, 7.20; cobalt, 0.53; phosphorus, 0.14; copper, a trace; insoluble in hydrochloric acid, 0.45.

Decomposition of Alkaline Chlorides.—(*Moniteur Scientifique*, No. 295).—According to Messrs. Kuentz and Jossinet, the decomposition of alkaline chlorides is readily and economically effected by the combined agency of heat and high-pressure superheated steam; the chlorides are brought to fusion, and while in that state a jet of steam, as just described, is forced through the fused mass; hydrochloric acid is formed together with a caustic alkali, or if, at the same time, carbonic acid is injected along with the steam, the carbonate of the alkali is formed.

Reduction of Chloride of Silver.—(*Zeitschr. f. Anal. Chem.*)—According to Gröger, an ammoniacal solution of chloride of silver is very completely reduced by placing therein tolerably large lumps of zinc; the solution is best placed in a wide-mouthed glass-stoppered bottle, and this requires to be shaken frequently; there should be zinc in excess. When the fluid, on a drop thereof being tested, no longer yields a precipitate with hydrochloric acid, the operation is finished; the silver is then separated by pouring the fluid off from the spongy mass, and washing by decantation; the pieces of zinc having been removed, the spongy silver is washed with pure strong hydrochloric acid, and next with water. The silver thus obtained is, according to the author chemically pure.

On the Action of Sulphuretted Hydrogen Gas upon Oxide of Iron and Hydrated Oxide of Iron.—(*Fourn. f. Gasbeleuchtung*, 1869, No. 2).—M. E. Brescius, at Frankfurt-on-the-Maine, has instituted a series of long-continued experiments in reference to the above subject and its special bearing upon the illuminating gas purifying process, known as "Laming's," when lime purifiers are applied not simultaneously for the purpose. As result of the researches and experiments of Brescius we find—1. That when sulphuretted hydrogen gas acts upon hydrated oxide of iron at the ordinary temperature of the atmosphere, there is formed sesqui-sulphuret of iron, Fe_2S_3 , according to the formula— $\text{Fe}_2\text{O}_3 + 3\text{HS} = \text{Fe}_2\text{S}_3 + 3\text{HO}$. 2. Perfectly dry sulphuretted hydrogen gas has no action whatever upon perfectly dry oxide of iron. The experiments are fully described in a lengthy paper.

New Preparation of Dithionate of Soda, &c.—(*Les Mondes*).—On shaking nitrite of oxide of amyl with a solution of bisulphite of soda, the dithionate is obtained in the form of a white crystalline mass. The method for the preparation of hyponitric acid, by means of nitric acid and arsenious acid, does not give a pure product. If nitrite of oxide of amyl is treated with chlorhydric acid, hydrate of oxide of amyl and chloride of ammonium are obtained; no amylamide can be found in the products. By causing hyponitric acid to act on essence of gaultheria, nitro- and binitrosalicylate of oxide of methyl are produced with a separation of oxide of nitrogen. Nitrosopiperidine and nitrosodiethylamine, obtained by MM. Th. Wertheim and A. Geuther, must be regarded as nitro bases. These compounds are kinds of amides of nitric acid, and are obtained by a loss of water in the corresponding nitrites.

Preparation of Carbonic Acid.—(*Revue Hebd. de Chim.*)—Messrs. Rousseau and Piedbœuf propose to obtain carbonic acid from sulphate of lime (plaster of Paris), by heating in retorts, arranged and made as those in use at gas works, a mixture of the material alluded to and charcoal or coke. The decomposition which ensues is represented by $\text{SO}_3\text{CaO} + \text{C}_2 = \text{SCa} + 2\text{CO}_2$.

A Peculiarity concerning Anthracite.—(*Revue Hebd. de Chim.*)—In the mountains near Aosta, Italy, an anthracite is found, which, on account of containing too much iron pyrites, has very little value as fuel. According to the observations of Deyeas, this substance has antiseptic properties, and has been applied to kill insects and as a suitable manure to vineyards; he also observed that, when given to pigs, at a dose of 20 grammes daily, it greatly assists the fattening of them.

Analysis of the Slime and Mud of the River Nile, by M. A. Houzeau.—(*Comptes Rendus*).—One hundred parts of air-dried mud contain:—Water, driven off at 110°C ., 7.70; clay and sand, 62.71; oxide of iron, magnesia, and small quantity of phosphate of iron, 14.70; carbonates of lime and iron, 0.57; alumina, 8.27; sulphate of lime, 0.56; organic matter and loss, 5.49; nitrogen in 100 parts, 0.0504. The author has also determined the composition of the water of the Nile during its periodical flood, and has paid special attention to the quantity of nitric acid and ammonia; among the curiosities of the results is, that the Nile carries every week into the Mediterranean a quantity of 6,000,000 of kilogrammes of ammonia.

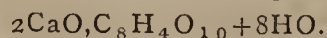
Fluorine in the Brain.—Professor Horsford, of Yale College, has tried to detect fluorine in the human brain, he was induced to do so by the fact that fluorine so frequently accompanies phosphoric acid in the mineral kingdom, and also on account of the large proportion of phosphoric acid found in the brain and nerves by Von Bibra and others. After having very carefully ascertained that the reagents he was about to apply were quite free from fluorine, the learned professor operated upon a human brain which had been long kept in spirits of wine, but which in consequence of neglect had, by the evaporation of the liquor, become wrinkled up and dry. A series of carefully made experiments proved undoubtedly the existence of fluorine in the brain.

New Series of Platinum Compounds.—(*Poggendorff's Annalen*, vol. 136, part i., 1869).—R. Schneider has discovered a new series of crystallisable platinum compounds, wherein stannous oxide and stannic acid play an important part. He first describes a compound containing 29.10 per cent platinum, 57.05 per cent tin, 13.85 per cent oxygen. This is called by him stannate of stannous protoxide of platinum. On treating this compound in the moist state with an aqueous solution of an alkali, soda for instance, he obtains a compound containing in 100 parts—Platinum, 50.0; tin, 29.3; sodium, 6.0; oxygen, 13.5; this is $\text{NaPtSn}_2\text{O}_8$, or stannate of protoxide of platinum and soda. The author further describes at very great length kalium platin-oxysulpho-platino-stannate, that is to say a compound containing in 100 parts Pt, 59.47, Sn, 11.86, K, 7.76, S, 19.35, O, 1.79, and also natrium platin-oxysulpho-platino-stannate, composed in 100 parts of Pt, 61.41, Sn, 12.02, Na, 4.73, S, 19.66, O, 1.80.

Reduction of Oxides by Hydrogen.—(*Poggendorff's Annalen*, vol. 136, part i., 1869).—M. W. Müller has instituted a series of experiments with the view to determine precisely the temperature at which the oxides of metals begin to be reduced by hydrogen gas. He has experimented with oxides of various metals prepared in various ways, and also determined the effect of other gases, nitrogen, and aqueous vapour, upon the temperature of incipient reduction. Oxide of iron prepared by cautiously heating metallic iron in contact with air was found to get reduced at 285°C .; the same oxide prepared from nitrate of iron was reduced at 286° ; when rather moist hydrogen was applied and the oxide of iron prepared from oxalate of the protoxide, the temperature of reduction was found to be 278° . Oxide of copper prepared from the sulphate of that metal and precipitated by caustic soda, and previously heated to 300° , was found to become reduced at 135° ; strongly ignited oxide of copper became reduced at 142° on an average of five experiments; oxide of cobalt becomes reduced at about 132° ; oxide of zinc could not be reduced at a temperature whereby glass became fused; oxide of tin, about 174° ; oxide of lead, at from 310° to 315° ; peroxide of mercury, 230° ; oxide of silver, at between 73° and 78° . The experiments have been extended to the chlorides and sulphides of some metals. Chloride of gold does not appear to be acted upon below 200° , but at a higher temperature an explosion took place. The action with chloride of platinum was rather strong at 85° , and rather violent at 165° ; reduction of the metal took place. The chlorides of silver and lead are not reduced below the boiling point of mercury, but require a red heat; sulphide of gold is reduced at 200° , while sulphide of platinum is reduced at the ordinary temperature, sulphuretted hydrogen gas being formed in both cases.

Quantitative Estimation of Tartaric Acid.—(*Pharm. Zeitschr. f. Russ.*, 1869, No. 1).—Dr. Martenson, First Assistant in the Chemical Laboratory of the Pharmaceutical Institute of Dorpat, Russia, has made a series of experiments, with the view to obtain a trustworthy and readily executed method of quantitative estimation of tartaric acid. After first ascertaining by a series of experiments that tartrate of lime is less soluble in water than is commonly reported in books (he ascertained that 1 part of the aforesaid salt requires at 18°C . 2388.26 parts of water for complete solution), he discovered the almost complete insolubility of the tartrate of lime in alcohol of 85 per cent strength. In order to estimate the tartaric acid in tartrate of potash, for instance, the salt is dried at 100°C ., dissolved in a small quantity of distilled water, next pure chloride of calcium solution is added, with the precaution to avoid excess thereof, afterwards a few drops of lime-water are added, and the porcelain capsule wherein this operation is per-

formed is left standing for some hours. A crystalline precipitate is thus obtained; it is collected on a filter previously dried at 100° and weighed; the supernatant fluid is first poured upon the filter, then the precipitate is collected and washed with strong alcohol, the precipitate and filter are thoroughly dried at 100° , the precipitate is weighed as—



It is of importance to take care to use a porcelain basin the glaze of which is quite free from cracks, otherwise the precipitate has a strong tendency to adhere to such portions of the basin. When either hydrochloric or nitric acids are present along with tartaric the fluid is first nearly neutralised with pure carbonate of lime and warmed to expel carbonic acid, while the last traces of acid are removed with lime-water. The presence of either chloride of ammonium or chloride of calcium in excess interferes with the correctness of the results and makes it necessary to add alcohol to the liquid to be operated upon. Results are accurate when proper care is taken.

Detection of Sulphur by means of Potassium or Sodium.—(*Zeitschr. f. Anal. Chem.*, 1869).—Dr. Schönn, at Stettin, recommends the use of either of these two metals for ascertaining the presence of sulphur in oxidised or non-oxidised state in inorganic compounds; a small quantity of the substance to be tested for sulphur is pulverised and placed in a dry test tube, a small piece of potassium or sodium is then added, and upon it a small quantity of the powdered substance which is to be tested is again placed in the test tube; heat is applied, reduction takes place, and sulphide of the metal is formed. The test tube, after cooling, having been broken, its contents are placed in a small quantity of water rendered acid by a few drops of sulphuric acid; sulphuretted hydrogen is evolved. If the quantity of sulphide formed is likely to be very small, nitroprusside of sodium should be used as a test. Care should be taken that only small quantities of substance are operated upon in this manner, especially since substances as realgar, orpiment, and others containing sulphur and arsenic, at the same time, violently explode and detonate when ignited with the above-named metals.

For Detecting Sulphur in Organic Substances, especially of Animal Origin.—(*Zeitschr. f. Anal. Chem.*, 1869).—The same process is available. Hair and feathers, and dry skin and nails, may be at once submitted to ignition with the metal. White of egg, emulsin, saliva, and muscle, should first be calcined on a piece of platinum, and the animal charcoal so obtained be ignited along with potassium or sodium. In most cases of this kind, nitro-prusside of sodium will be required to make the presence of sulphur absolutely evident.

Detection of Phosphorus by means of Magnesium.—(*Zeitschr. f. Anal. Chem.*, 1869).—Dr. Schönn, at Stettin, found that when previously well dried (previous ignition is often required) inorganic combinations of phosphorus and phosphates, even if they are mixed with sulphates, are ignited in pulverised state in a test tube with small quantities, say from 5 milligrammes to 1.5 centigrammes of magnesium wire, ribbon, or better still, pure magnesium in powder, there is formed phosphide of magnesium. After cooling, the fused mass, on being moistened with water, will disengage phosphuretted hydrogen gas, which, in many instances, will be found to be the spontaneously inflammable variety of that compound. Phosphorus may be detected in the same way in organic substances; as, for instance, brains, muscle, &c.; but these should be previously calcined, and the dry animal charcoal so obtained submitted to the experiment.

Detection of Ozone in the Atmosphere.—(*Zeitschr. f. Anal. Chem.*, 1869).—Dr. Van Huizinga has made a series of experiments to compare the relative value of mixed iodide of potassium and starch, and of protoxide of thallium, for the detection of ozone in the atmosphere. He comes to the conclusion that neither of these two reagents are quite so reliable in all respects as is desirable, but the latter deserves preference. A series of comparative experiments were made by the author and Dr. Van Ster; the former being on the island of Texel, the latter at the Helder, and experimenting with paper prepared with iodide of potassium and starch. The thallium paper was impregnated with a preparation obtained by precipitating the sulphate of thallium with baryta water. The paper contained, for every square centimetre surface, about 1 milligramme of protoxide. It is well known that protoxide of thallium is changed by ozone into the brown oxide of that metal.

Detection of Picrotoxin in Beer.—(*Zeitschr. f. Anal. Chem.*)—Köhler's method for the detection of picrotoxin, the active and poisonous principle of *cocculus indicus*, is based upon the fact, that when ammonia is present, acetate of lead precipitates as insoluble matter from beer, such substances as dextrin, gum, glucose, while the picrotoxin, which is not thus precipitable, can be removed by means of ether from an acidified fluid. The beer to be tested is first mixed with ammonia until it is distinctly alkaline, the ensuing precipitate of phosphates is allowed to settle, and after the fluid has become clear, a boiling hot and concentrated solution of acetate of lead is cautiously added as long as a precipitate ensues; excess of lead solution should be avoided. The precipitate so obtained should be collected on a filter and washed with hot alcohol for a short time; from the filtrate, the lead is removed by means of sulphuretted hydrogen gas, the sulphide of lead removed by filtration, and the filtrate evaporated on a water-bath to the consistence of a syrup; the fluid obtained is treated with ether, the latter separated from the aqueous residue, and the ether removed by evaporation. Picrotoxin reduces the oxide of copper to protoxide, is soluble in sulphuric acid, exhibiting a saffron yellow coloured fluid. When bichromate of potash is added to the sulphuric acid solution, a violet colouration ensues, which ends by becoming bright green. If the beer contains strychnia simultaneously with picrotoxin, or extract of *cocculus indicus*, the strychnia remains behind in the syrupy fluid which remains after the ether is separated therefrom by means of a stoppered funnel.

Molybdic Acid a Test for Morphia.—(*Zeitschr. f. Anal. Chem.*, 1869).—M. Almén has thoroughly tested the value of Fröhde's test for morphia—sulphuric acid which is contaminated with, or contains molybdic acid, purposely added. A beautiful purple tint is produced when such acid is brought into contact with either pure morphia or its salts.

Solubility of Silico-fluoride of Potassium in Dilute Hydrochloric Acid.—(*Zeitschr. f. Anal. Chem.*, 1869).—Since hydro-fluosilic acid is sometimes resorted to in the quantitative estimation of potash, it should be borne in mind that, even though alcohol be used to increase the insolubility of the silico-fluoride of potassium, F. Von Stolber has observed that 1 part of this salt is dissolved by 409 parts of weak hydrochloric acid, containing 1.8 per cent real acid; while the stronger the acid becomes, the greater also the solubility, even at a temperature of 14° C.

Ebullition of Water.—(*Poggendorff's Annalen.*)—In reference to the well-established fact that water, after having been deprived of air as much as possible, either does not boil at all when heated, or does so with violent sudden starts and concussions, some experiments have been made by Kremers, who observed that, in order to assist in expelling air from water, the addition of spirit of wine, in the proportion of one part of the latter to three of the former, is very useful. He cautions against a danger which exists when such a mixture is heated too rapidly, since it is very apt to boil over, especially after a portion of the spirit has evaporated. It is rather curious that, though both the water and spirit of wine employed were pure, the mixture, when boiling, should assume a greenish yellow hue, which disappears again on cooling; the boiling point of the fluid easily becomes as high as 109°. As a result of a large number of experiments, the author finds that water, as fully deprived of air as possible, may be heated as high as from 180° to 200° C., without boiling permanently.

Elementary Organic Analysis.—(*Zeitschr. f. Anal. Chem.*)—Messrs. Stern and Calberla recommend the use of pure metallic silver instead of copper turnings in the elementary organic analysis when, nitrogen being present in the substance submitted to combustion, pure, clean metallic copper turnings are, as is well known, placed in the front end of the combustion tube in order to reduce any binoxide of nitrogen which may be formed. The authors prefer silver on account of the non-necessity for reducing this metal again by means of hydrogen after the combustion is ended. Silver, according to their researches, answers all the purposes of copper admirably well.

Testing Opium.—(*Zeitschr. f. Anal. Chem.*)—Professor Schneider has proposed in the 6th revised edition of the *Pharmacopœia Austriaca*, the following method for testing the goodness of opium. Ten grammes of previously dried and powdered opium is treated with a mixture of 150 grammes of distilled water, to which 20 grammes of pure hydrochloric acid, sp. gr. 1.12, is added; the residue, after extraction, should not exceed 4.5 grammes weight; to the acid fluid 20 grammes of common salt are added, and the precipitate thereby caused is collected, after 24 hours, on a filter, and the latter washed with a solution of common salt; to the filtrate, ammonia is added, and the fluid left standing again for 24 hours; the crystals which have separated are collected, re-dissolved in acetic acid, and precipitated with ammonia; the precipitate so obtained is washed, dried, and weighed; its weight should not be less than 1 gramme.

NOTES AND QUERIES.

Substitute for Black-Lead for Stoves.—A concentrated solution of silicate of potash or soda, to which may be added mineral substances as colouring matter; for instance—for white, tin-ash, precipitated sulphate of baryta, oxide of zinc, and the like; for red, Venetian red and divers shades of oxide of iron, also red ochres; blue, ultramarine, cobalt blue, and such like substances; but the question is, even if the drying goes on well, will not the dry material scale off readily again; of course it will somewhat depend on the more or less roughness of the surface of the iron. Paint made with boiled linseed oil is out of the question where heat has to be endured, and, moreover, it sticks to iron, in consequence of the peculiar properties of the oil itself. There is no patent for the employment of silicate of soda.

Skeleton Lectures.—There is now some hope that scientific instruction will in future form no inconsiderable part in the educational curriculum of our public schools and schools in general. I believe the extension of this important branch of knowledge may be greatly extended amongst those who have passed their school days without this advantage if some enterprising philosophical instrument maker, would supply skeleton lectures with the necessary instruments and apparatus to illustrate them on loan and reasonable terms. "Skeleton Sermons" are much in vogue, and why not skeleton lectures on science, well arranged and adapted for the special experiments to make them both interesting and intelligible. I am quite sure there are hundreds of intelligent persons who now devote themselves to "Penny Readings" would be too glad to give brief lectures on popular science, if they could only hire the necessary apparatus, &c, to give them interest; a scientific lecture without experiments, is like a body without life. I shall be glad to see this suggestion carried out.—W. LITTLE, Heckington Hall, Lincolnshire.

Detection of Minute Traces of Hydrocyanic Acid.—Pagentecher some time ago pointed out that guaiacum resin with hydrocyanic acid, and some salt of copper, caused a blue colouration. More recently Schönbein has shown how to prepare test paper of great sensibility with tincture of the above named resin, for detecting

hydrocyanic acid; but the following observation of the same sensibility of the shavings from which the resin is derived, especially with the shavings of the *lignum sanctum*, is, I believe, new. Moisten a few shavings with a weak solution of sulphate of copper, place then on a piece of perforated paper over the mouth of a bottle containing cherry-laurel water; after a few minutes the colouration will take place. By the same way I have confirmed M. Louget's observation of the existence of a minute dose of a cyanide in salivation. Moisten a few shavings with the weak solution of copper, upon simply spitting upon it, immediately the blue colour will appear.—S. CONNE, London, April 5, 1869.

On a Momentary Molecular Change in Iron Wire.—Mr. Gore, F.R.S., whilst making some experiments on heating strained iron to redness by means of voltaic electricity, observed that, on disconnecting the battery and allowing the wire to cool, during the process of cooling the wire suddenly elongated, and then gradually shortened until it became quite cold. The amount of elongation of the wire during the momentary molecular change was usually about 1-240th part of the length of the heated wire; the molecular change evidently includes a diminution of cohesion at a particular temperature during the process of cooling, and it is interesting to notice that at the same temperature during the heating process no such loss of cohesion nor any increase of cohesion takes place; a certain temperature and strain are therefore not alone sufficient to produce it, but the condition of cooling must also be included. A large number of experiments were made with great care with wires of palladium, platinum, gold, silver, copper, lead, tin, cadmium, zinc, brass, German-silver, aluminium, and magnesium, but in no instance could a similar molecular change to that observed in iron be detected. This molecular change would probably be found to exist in large masses of wrought-iron as well as in small specimens of wire, and would come into operation in various cases where those masses are subjected to the conjoint influence of heat and strain, as in various engineering operations.

MEETINGS FOR THE WEEK.

MONDAY, 12th.—Medical, 8.

TUESDAY, 13th.—Royal Institution, 3. Professor Grant, "On Stellar Astronomy." Photographic, 8.

WEDNESDAY, 14th.—Society of Arts, 8.
— Geological, 8.
— Microscopical, 8.

THURSDAY, 15th.—Royal Institution, 3. Professor Tyndall, "On Light."
— Royal, 8.30.
— Chemical, 8.
— Royal Society Club, 6.

FRIDAY, 16th.—Royal Institution, 8. W. Carruthers, Esq., "On the Cryptogamic Forests of the Coal Period."

SATURDAY, 17th.—Royal Institution, 3. A. Geikie, Esq., "On the Origin of Land Surfaces."

TO CORRESPONDENTS.

Communications have been received from O. Lodge; W. H. Walenn; Dr. E. Fleischer; R. Calvert Clapham; W. H. Perkin, F.R.S.; W. Smith; J. Barrow; H. McLeod; L. W. Leeds; C. H. Osborn; Dr. Letheby; A. G. Pritchard; J. W. Young; L. Walters; E. T. Chapman; C. S. Watson; J. Fisher; Pierre Clavel (with enclosure); W. M. Watts; E. Smith, M.A.; J. W. Slater; H. J. Jones; W. H. Darlington; G. Cranston (with enclosure); J. C. Lee (with enclosure); The Bede Metal Company; W. Wallace; H. C. Sorby, F.R.S.; A. H. Church, M.A.; Dr. E. Davy (with enclosure); F. S. Sillitoe; Gossage and Sons (with enclosure); Mottershead and Co. (with enclosure); W. J. Morgan; E. Bird; and Dr. Röhrig.

BOOKS RECEIVED.

Thèses Présentées à la Faculté des Sciences de Paris, pour obtenir le Grade de Docteur es Sciences Physiques. Par M. Stanislas Meunier. Paris: Gauthier-Villars.
Power Without Fuel: an Investigation of the Means by which it may be obtained from the Heat of Natural Sources. By James S. Baldwin. New York: Willham H. Winans and Co.
History of Chemical Theory. By Ad. Wurtz. Translated and Edited by Henry Watts, B.A., F.R.S. London: Macmillan.
On the Application of the Conversion of Chlorates and Nitrates into Chlorides, and Chlorides into Nitrates, to the Determination of Several Equivalent Numbers. By Frederick Penny, Esq.
Proceedings of the American Association for the Advancement of Science. Cambridge: Joseph Lovering.
Lectures on Ventilation. By Lewis W. Leeds.
Observations on some of the Fundamental Principles and Existing Defects of National Education. By Neil Arnott, M.D., F.R.S., &c. London: Longmans, Green, and Co. 1869.
The Elasticity, Extensibility, and Tensile Strength of Iron and Steel. By Knut Styffe. Translated from the Swedish by Christer P. Sandberg; with a Preface by John Percy, M.D., F.R.S. With 9 lithographic plates. London: John Murray.

THE CHEMICAL NEWS.

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ANOTHER NEW ELEMENT ASSOCIATED WITH ZIRCONIUM.

FROM a letter received from Mr. H. C. Sorby, dated April 13th, we learn that he has discovered spectrum evidence to prove that, independent of jargonite, zircons from different localities contain two distinct earths, occurring in very variable proportion, so that some appear to contain little or none of one, and others to be chiefly composed of it.

ON THE PITCHSTONES OF THE ISLAND OF ARRAN.

By J. WALLACE YOUNG.

THE pitchstone dykes and veins in Arran are of great interest to the geologist, the mineral being comparatively rare in Britain.

Pitchstone appears of a dark blackish green colour, almost like a piece of bottle glass, sometimes with small specks, and, occasionally, large crystals of felspar disseminated in the base, giving it a more or less porphyritic texture.

When small chips, or properly prepared sections are examined microscopically, it is seen to consist of a colourless glassy base—probably a hydrated felspar, and having, according to Mr. Sorby, no action on polarised light. Scattered throughout are great numbers of dark green prismatic crystals, crossing in all directions, and often in stellate groups. On applying heat to a thin splinter, water is expelled, and it becomes opaque, the opacity being due to the minute vesicles produced by the expulsion of the water.

B.B. pitchstone becomes white, and fuses with difficulty to a very vesicular glass. Fracture, conchoidal, splintery.

The finely elutriated mineral is acted on to a slight extent by digestion with HCl; with HS₂O₄ the action is a little greater.

Pitchstone, when weathering and decomposing, becomes opaque and greyish white, and is not difficult to pulverise. In this state it is acted on very considerably with HCl; the SiO₂ separating partly in a gelatinous form. A specimen of weathered pitchstone from the Corrugills shore, dried at 100° C., lost 11.69 per cent of water on ignition.

The following table shows the compositions of four different specimens:—

	I.	II.	III.	IV.
Silicic acid.. ..	72.55	73.00	71.94	71.27
Alumina	12.08	12.27	12.31	11.60
Ferrous oxide	1.50	1.27	1.31	1.69
Lime	0.50	0.50	0.80	0.95
Potash	4.32	3.92	4.27	4.17
Soda (by difference)..	3.64	3.92	4.00	3.45
Water.. ..	5.41	5.12	5.37	6.87
	100.00	100.00	100.00	100.00

No. 1. From the large vein on the Corrugills shore. This forms a broad, almost horizontal band in front of the sandstone cliffs. A few small felspar crystals scattered throughout the smooth, blackish green mineral. Sp. gr. 2.336.

No. 2. From the great vein, about 30 feet broad, which crosses the old Lamplash Road at right angles. More

porphyritic in character than any of the others. Sp. gr. 2.327.

Nos. 3 and 4. From Moneadh-Mhor Glen. The two pitchstone dykes are well exposed in the bed and banks of the stream. No. 3. Blackish green; smooth. Sp. gr. 2.343. No. 4. Greyish green; texture somewhat coarse. Appears as if in a state of incipient decomposition. Sp. gr. 2.323.

From the microscopical examination of a great many different varieties, it would appear that the more porphyritic kinds show the greatest number of green prismatic crystals. In the specimens Nos. 1 and 3, they are not so numerous; but higher microscopic powers show immense quantities of very small, needle-shaped crystals disseminated throughout, and frequently surrounding the larger crystals like a fringe, appearing to have separated out and grouped themselves in this manner, the base in the neighbourhood being comparatively free from them. The larger crystals have apparently been first formed, and in some cases, have acted as a sort of nucleus for the smaller ones.

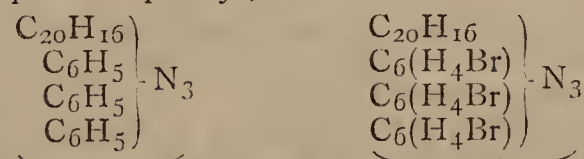
ON SOME NEW ANILINE DYES.

By W. H. PERKIN, F.R.S., SEC. C.S.

At a recent meeting of the Chemical Section of the Philosophical Society of Glasgow, Mr. Perkin made some observations upon artificial colouring matters, which he illustrated experimentally.

The first remarks were upon the action of chloride of lime on aniline, the formation of Runge's blue, and its conversion into mauveine, being shown. The particulars of these results have already appeared in the CHEMICAL NEWS.

An instance of how little the replacement of hydrogen by bromine in a colouring matter will at times influence its colour and properties, was shown and remarked upon by the formation of a blue the author had produced from a salt of rosaniline and bromaniline. This blue possesses both the colour and most of the properties of ordinary triphenyl-rosaniline, although it must contain bromophenyl in place of phenyl, thus:—



Tri-phenyl-rosaniline. Tri-bromophenyl-rosaniline.

This substance appears to differ from the ordinary blue only in being less soluble in alcohol.

An experiment was then made in reference to the peculiar property mauveine possesses of becoming colourless, like indigo, with reducing agents, and then assuming its ordinary colour again when exposed to the oxidising influence of the air, a property showing this colouring matter to belong to a different class of compounds to rosaniline.

The next subject was in relation to a colouring matter which had been obtained several years since by Mr. Perkin, but only in small quantities, in the preparation of aniline purple with bichromate of potassium and a salt of aniline. This substance produces, upon silk or cotton, shades similar to those obtained with safflower, and owing to a somewhat improved process for its production, endeavours are now being made to introduce it into the arts, especially as it possesses advantages over safflower. It is, however, still difficult to manufacture; it is called aniline pink, and sometimes safranine.

This substance is at present under examination; it does not appear to be at all related to rosaniline, but to possess properties similar to those of mauveine, as it gives the same reactions with acids, and with reducing agents becomes colourless, but, when exposed to the air, rapidly

assumes its original tint, exactly in the same manner as the mauve.

Like most of the coal-tar colours, it is an organic base. It forms very soluble salts, most of which are crystalline, and possessed a green metallic lustre.

One of the most remarkable of its properties is the peculiar orange-coloured fluorescence of the alcoholic solution of its salts. This was illustrated by means of the magnesium lamp.

Mr. Perkin has not yet decided upon the formula of this colouring matter, but is at present engaged with the subject. It appears to contain much less carbon than mauveine.

PRELIMINARY NOTICE

ON THE MINERAL CONSTITUENTS

OF THE

BREITENBACH METEORITE.*

By Professor N. STORY MASKELYNE, M.A.

THIS meteorite, which belongs to the rare class intermediate between meteoric irons or siderites, and meteoric stones or aërolites, was found in Breitenbach in Bohemia.

It is a spongy metallic mass, very similar to the siderolite of Rittersgrün in Saxony, the hollows in the iron being filled by a mixture of crystalline minerals. These minerals seem to consist almost entirely of two; and the present notice deals with these two minerals.

1. One of them is of a pale green colour, crystallising in the prismatic system, and presenting at once the formula of an augitic mineral and a crystalline form nearly approaching that of olivine.

The analysis of this green mineral gave, from 0.4127 grm.,—

		per cent.
Silica	0.2315	56.101
Magnesia	0.1247	30.215
Ferrous oxide	0.0560	13.583
	0.4122	99.899

results which correspond very nearly with an Enstatite of the formula $(Mg\frac{1}{2}Fe\frac{1}{2})SiO_3$. The specific gravity is 3.23.

2. The other mineral is one of very great interest. It is, in short, silica crystallised as tridymite. In bulk it forms about a third part of the mixed crystalline mass.

The crystals are very imperfect; but measurements accord with those of an hexagonal crystal.

A section made for examination in the microscope showed two small crystals in which the axis happened to be normal to the section. Light traverses these crystals with equal brilliancy during the rotation of the crystal between crossed Nicol prisms. That this was due to gyratory polarisation, and of a right-handed kind, was shown in the following manner:—

A comparative experiment was made with two sections of quartz of opposite qualities, and of the requisite thickness, to give the "sensitive tint" with crossed Nicols; and below these were placed two thin sections of right-and-left gyrating quartz, giving an orange tint. The two minute microscopic sections gave, on comparison of the colours in the centre of the field, in each case, unmistakable evidence that the gyration was similar to that of "right-handed" quartz.

There can be no doubt from these results that this mineral is silica in the form of its opaloid crystal, to which Von Rath has given the name of Tridymite.

The analysis of the mineral gave, by distillation of the silica as silicic difluoride, and subsequent determination as potassic fluosilicate, 97.43 per cent of silica; the re-

mainder being oxide of iron and lime. Thus 0.3114 grm. gave—

	per cent.
Silica	0.3034
Ferric oxide	0.0035
Lime	0.0018
	0.3087
	99.132

A second analysis gave 99.21 per cent silica, 0.79 of residue.

Its specific gravity, as determined from a very small amount of the mineral picked under the microscope, was 2.18; a second determination made on a larger amount gave the value 2.245. That of tridymite is 2.295 to 2.3. This may be taken as evidence that the mineral is not quartz, the specific gravity of which is 2.65. Von Rath's experiments were made on a rather less pure form of tridymite.

ON THE

DISTILLATION OF DENSE HYDROCARBONS AT HIGH TEMPERATURES,

TECHNICALLY TERMED "CRACKING."

By S. F. PECKHAM.

IN the American reprint of the CHEMICAL NEWS for June of this year, an article appears "On Naptha and Illuminating Oil from Heavy California Tar," by Prof. B. Silliman, copied from the *San Francisco Bulletin*. In the September number of the same journal, an article appears "On the Distillation of Hydrocarbons," by Joseph Hirsch, Ph.D., in which the results obtained by Prof. S. are subjected to criticism, and certain statements made in reference to the subject of a most extraordinary character.

At the same time that Mr. Corning was engaged upon the experiments, the results of which form the subject of Prof. Silliman's paper, I was engaged upon experiments of a similar character for the Geological Survey of California, the results of which have not yet been published.* These results differed somewhat from those obtained by Prof. S., as also the method by which they were obtained. I shall, therefore, give a brief summary, both of method and results, and compare the conclusions to be derived from them with the statements made by Dr. Hirsch.

Those who first attempted the manufacture of commercial oils from crude California materials, when operating with the upright still in common use for the manufacture of Pennsylvania oils, encountered an apparently insurmountable obstacle, viz., a large proportion of the distillate was neither light nor heavy, neither burning oil nor lubricating oil, but an oil intermediate in density between the two, and therefore not merchantable. The difficulty was so far overcome by enclosing the stills in brick-work, heating them entirely by radiant heat, and distilling very slowly, that the amount of heavy lubricating oil was largely increased, and the "middlings" correspondingly diminished. The yield of illuminating oil however, was very slightly increased, and it was for the purpose of securing a larger yield of that material, that my experiments were undertaken. I had at first intended to subject them to Mr. Downer's process of slow distillation in a high, upright still, the top of which was exposed to radiation. The small quantity of crude material at my command (5 gallons of each variety) rendered this operation exceedingly difficult to conduct successfully, and it was with extreme satisfaction that I saw at the time, in the October number of the CHEMICAL NEWS for 1866, an announcement that Mr. Young of Glasgow had

* The volume of Reports of the Survey on "Economical Geology," containing these results, is now ready for the press, but its publication is delayed by the failure of the last California Legislature in making the necessary appropriation.

* Abstract of a paper read before the Royal Society, April 8th, 1869.

obtained a patent for the manufacture of illuminating oils from heavy paraffine oils, by distillation under pressure. It was necessary that I should operate on a small quantity at a time, and also, that I should subject the four or five different samples which I had to the same treatment, in order that I might compare the results, and judge of their relative value. For that purpose I contrived the apparatus described in the September number of this Journal for 1867, which, so far as I know, has but one fault, viz., the chamber of the valve is too small, and should be enlarged sufficiently to enable the pressure to be regulated by weights instead of by a spring.

With a pressure of between 30 and 40 pounds per square inch (the exact amount was not ascertained) the following results were obtained:—

Percentage Results of Distillation under Pressure.

	I.	II.	III.	IV.
Volatile impurity, consisting of air and water	—	—	—	12.5
1st pressure distillation of crude material	91.1	87.66	82.86	72.2
Coke and loss at do.	9.1	12.34	17.34	15.5
1st fractionation of sp. gr. 43° B. = 0.810 . .	42.1	56.72	40.33	16.7
Leaving heavy residue for re-distillation	49.1	30.94	42.33	55.3
Which yielded, by 2nd pressure distillation	44.15	27.84	58.09	49.8
2nd fractionation of sp. gr. 43° B. = 0.810 . .	12.25	6.96	9.52	12.4
Total crude illuminating oil.	54.25	62.68	49.85	29.1
Loss in treatment of do. 3-100ths	1.62	1.88	1.49	0.9
Total yield of refined oil	51.25	60.70	48.36	28.2
Total crude lubricating oil	31.85	20.88	28.57	37.4
Loss in treatment of do. 3-100ths	0.95	0.62	0.85	1.1
Total refined lubricating oil	30.90	20.26	27.72	36.3
Yield of refined illuminating oil, sp. gr. 43° B.	51.25	60.70	48.36	28.2
Yield of refined lubricating oil, sp. gr. 23°				
—25° B.	30.90	20.26	27.72	36.3
Loss in treatment	2.61	2.50	2.34	2.05
Coke and loss in distillation	18.24	16.54	21.58	33.5
Yield of illuminating oil by ordinary process	15.00	20.00	3.00	2.0

No. 1 was an oil procured from one of the tunnels of the Hayward Petroleum Company, of a specific gravity of 0.9023, yielding by distillation in a common still about 15 per cent of light oil, of a specific gravity of 0.810, with about 40 to 50 per cent of "middlings" and 20 per cent of light lubricating oil.

No. 2 came from the celebrated Pico Spring, yielding the lightest oil of any natural outcrop in Southern California. Its specific gravity was 0.8932, and it yielded to treatment by the ordinary method only about 20 per cent of illuminating oil of the proper density.

No. 3 was from the Canada Laga, of specific gravity of 0.9184, and yielding by the ordinary process only 3 per cent of illuminating oil.

No. 4 was a sample of Maltha from the same spring as that operated upon by Prof. Silliman. Its specific gravity was 0.978, and it yielded about 2.5 per cent of illuminating oil.

This table exhibits the results of actual experiment, not of theory; and while they differ from those obtained by Prof. Silliman, the difference is in degree and not in kind, and is without doubt due to the superiority of the apparatus used by myself, and to a higher degree of pressure employed. Both series of experiments confirm each other, and alike prove that dense petroleums and a thick heavy tar—as thick as ordinary molasses—which yield practically little or no illuminating oil by ordinary treatment, by distillation under pressure are subjected to what is technically termed "cracking" and made to yield from 28 to 60 per cent of oil fit for burning, and rendered thereby nearly as valuable as the crude oils of Pennsylvania.

Dr. Hirsch criticises these experiments as not being executed under circumstances "parallel to the distillation on a large scale." He then states, that, during the distillation of hydrocarbons on the large scale, "the process of 'cracking' always takes place in some degree," as "all hydrocarbons of high boiling points contained in such mixtures are, during distillation, exposed to varying degrees of temperature below their own boiling point, as long as those hydrocarbons of lesser gravity and lower boiling point have not been removed by distillation." He further states, that "it is this exposure to a lower degree of heat than corresponds to

the distilling point of an oil of definite gravity, which comprises the operation of 'cracking.'" Again, he states, that during slow distillation in the enormous stills now being introduced, "cracking" takes place without any "special efforts" to produce such a result, "while only a small portion distils over as paraffine oil, that being due to over-heating." He next states, that by rapid distillation of a small quantity, the different hydrocarbons which make up the petroleum come over unchanged, and that the difference between this last-named distillation and the former, is the same as the one between distilling coal for the production of illuminating gas, and that for producing coal oil; the former producing a dense tar, being carried on in small low retorts, and the latter in revolving retorts of large capacity. "In these the oily vapours are exposed to a cooler temperature than their own with every revolution of the retort, and are in this manner broken up into oils of lighter gravity."

He then gives a number of rules, the result of his own experience.

"1st. * * * the more the temperature of the actual boiling point of oil of definite gravity is above the temperature to which the same oil is raised, the greater is the quantity of light oil obtained.

"2nd. The gravity of distillate resulting from reduction of temperature will be directly proportionate to said reduction. * * * In distillation, the temperature, therefore, should always be reduced to the boiling point of the oil of the specific gravity desired.

"3rd. The difference between the temperatures of the two boiling points, viz. of the oil being subjected to distillation and of the derived distillate, is in direct proportion to the height of the still employed, or to the facility for cooling the upper portions of the still.

"4th. The intensity of the process of 'cracking' is proportionate to the suddenness with which the oil vapours are condensed before leaving the still.

"5th. The difference in gravity between that of the oil distilled and the desired distillate is in direct proportion to the quantity of water produced in the process.

"These laws are the same with hydrocarbons distilled under the ordinary atmospheric pressure, as with those distilled in a vacuum, or under increased pressure."

It is very rarely that as many errors are included within as little space, and the entire discussion exhibits in a remarkable degree to what totally erroneous conclusions the results of close observation and experience may lead when explained upon a false hypothesis.

The operation of "cracking," as conducted by Mr. Downer, consists in a slow distillation of oils of high specific gravity, and high boiling point, in a still furnished with a high dome, the outer surface of which is freely exposed to radiation. As distillation proceeds, those oils which are condensed at the temperature at which the dome is maintained, instead of passing into the worm and thence into the receiver, collect in drops upon the surface of the dome, and fall back upon the surface of the oil beneath, which has meantime become heated above their boiling points. Mr. Young distils the oils under pressure, thereby vapourising them at a temperature above their normal boiling points.

It is therefore obvious that the primary and essential condition of "cracking" is simply to subject the oils to a temperature above their boiling points, or in other words, to super-heat their vapours. It will be found that, for oils of the same density, the higher the temperature to which they are raised, or at which they are distilled, the lighter will be the product; and that to produce an oil of given density, the heavier oil must be raised to a certain fixed temperature, the intensity of heat depending on the lightness of the oil required.

Now it is evident that Prof. Silliman could not subject five or ten gallons of Maltha to experiment strictly analogous to Mr. Downer's process, the two elements of time and large capacity of apparatus being practically unattainable when manipulating so small a quantity. He

could, however, follow Mr. Young's process strictly, using from 10 to 15 pounds pressure per square inch. My own results were obtained by using from 30 to 40 pounds pressure per square inch, and operating upon only 1,500 c.c. at a time.

Dr. Hirsch is correct in stating that during the distillation on the large scale, this process always obtains action in some degree, but his reasoning is utterly at fault. So, too, in his explanation of the fact, that "cracking" takes place in large stills without any special effort to secure such a result. The real explanation lies in the fact, that the upper portion of stills in ordinary use is generally exposed to atmospheric currents and radiation. With such an arrangement it is impossible, upon Mr. Downer's plan, to prevent more or less condensation upon the dome, and consequent "cracking," especially toward the end of the operation, in stills of the enormous capacity of 40,000 gallons, where all the conditions essential to his process are present. It was in stills set in this manner that the heavy California oils were first distilled, and in which they were "cracked" to an oil of medium density; but when the sides and domes of the stills were surrounded with brick-work, the vapours were no longer condensed, and they passed unchanged into the receiver.

Dr. Hirsch is again in error in supposing that paraffine oils are produced by a high temperature. I am told that Mr. Downer has made illuminating oils, by "cracking" solid paraffine wax by means of his process. The paraffine lubricating oils of commerce are now most successfully produced from coals, by distilling the material in large kilns, in which combustion takes place at the upper surface, and the draft is conducted downward, insuring the expulsion of the volatile products at the very lowest temperature possible.

He is yet again in error in the analogy which he assumes to exist between rapid and slow distillation of petroleum and the distillation of coals in small retorts to produce illuminating gas, and in revolving retorts to produce oil. Rapid distillation "cracks" the oil, because it necessitates increased temperature to force the vapours from the still. Such as been my experience repeatedly on both the large and small scale. Slow distillation yields the hydrocarbons unchanged, provided the vapours have ready egress from the still, because distillation is then carried on at the lowest temperature attainable. Small retorts are used for the manufacture of gas, in order that the coal may the sooner be raised to the red-heat, and the greatest possible "cracking" effect be experienced, while revolving retorts are used for the manufacture of oil, not that the charge may be repeatedly cooled, but in order that it may be uniformly heated, avoiding the necessity of over-heating the portion next the fire, in order that the upper portion may be heated sufficiently.

His first and second rules, when reduced to plain English, assert that that "cracking" may be produced by refrigeration. Following their lead, in order to produce from paraffine wax the lightest member of the naphtha series isolated by Prof. Warren, and boiling at 0° C., the paraffine should be immersed in melting ice. According to these rules, the best method of producing illuminating gas from crude petroleum would be to subject the oils to the action of a refrigerating mixture of solid carbonic acid and ether, instead of allowing them to drip upon red-hot coke.

His third rule is correct, as the lower the temperature at which the top of the still is maintained, the lower will be the boiling point of the liquid resulting from the condensation of the vapours that escape.

His fourth rule is too obscure in its signification to admit of criticism.

His fifth rule is of the most extraordinary character. Chemistry is not yet ready for the announcement of the transmutation of one element into another, and such transmutation must certainly take place if *water* can be produced by distillation of volatile hydrocarbons, with exclusion of *oxygen*. So, too, is it almost equally difficult to imagine how any general laws can be "the same" for

two processes so diametrically opposed as distillation in a vacuum and under pressure.

I desire in this connection to note a few suggestions which have occurred to me in reference to this subject. In the last edition of Prof. Dana's Mineralogy (1868), he has classified the results obtained by Profs. Warren and Storer, and arranged the hydrocarbons isolated by them in three groups, viz., the Naphtha and Beta-naphtha series, and the Pittoleum group. The first two are isomeric, the last contains more carbon in proportion to its hydrogen. The members of the Pittoleum group at present isolated are doubtless the lower members of a large group, the higher members of which have very high boiling points; or perhaps still there is another group containing a still larger proportion of carbon. As the different members of these groups decrease in density, the proportion of hydrogen increases, and as they increase in density the proportion of carbon increases. The process of "cracking" Pennsylvania oils, therefore, is simply subtraction of carbon; and it appears from the results of experiment and analysis, that each additional atom of carbon is held by a feebler affinity than the last, consequently the stability of the members increases as the proportion of carbon decreases. The lower the member is in the series, the stronger is the affinity of the hydrogen for the carbon, and consequently, the higher is the temperature required for the production of the member next below it. Thus it is that over-heating dense paraffine oils produces medium or illuminating oils; over-heating illuminating oils produces still lower and more volatile liquids; at a still higher temperature the products become gaseous, and at an excessively high temperature, light rather than heavy carburetted hydrogen gas is produced.

In the absence of actual demonstration by fractionation, I am led to believe from the behaviour of California petroleum, that they do not contain either the Naphtha or Beta-naphtha series in appreciable quantity; nor do they contain the members of the Pittoleum group yet isolated in large proportion, but are doubtless made up of the higher members of that group, or a still more highly carbonised and unstable group not yet described, with which is mingled one or more nitro-hydrocarbons yet more easily decomposed. Be this fact or fancy, the appearance and physical properties of the refined pressure distillate from these oils, lead to the opinion that it is made up of the same members of which refined Pennsylvania petroleum is composed. The lightest oils existing in crude California petroleum change in a few weeks, after treatment, to a dirty yellow colour, even when tightly corked and exposed only to the light. A bottle of refined pressure distillate in my possession has now been prepared nearly two years, yet its colour has scarcely changed perceptibly.

By Prof. Warren's process of fractionation only a trace was eliminated from any of my samples of crude California oil under 150° C., yet in one instance, when my valve accidentally stuck so that the pressure was very considerably increased above 40 pounds, the vapours when they escaped passed through the worm uncondensed at 8° C., and melted the lead pipe at its point of connection with the retort; proving that, as in the case of the heavy paraffine oils, decrease in the density of the distillate follows any considerable increase in the temperature of distillation.

I hope at some future day to be able to fractionate both the crude California petroleum, and the products of their distillation under pressure, and thus obtain some additional facts in reference to this interesting question.—*American Journal of Science*, January, 1869.

Cement for Leather is best made by mixing with ten parts of sulphide of carbon one part of oil of turpentine, and adding thereto so much gutta-percha, as, by dissolving in this mixture, will form a tough, thickly-flowing liquid, like treacle. The cement is applied to both pieces to be joined, the surfaces brought into contact, and pressure applied until the joint is dry. One essential requisite of success is the perfect freedom of the surfaces to be joined from all grease.—*Coach makers' Journal*, U.S.

ON THE
ESTIMATION OF COPPER IN ORES,

BY CERTAIN METHODS FOR WHICH A PREMIUM HAS BEEN
AWARDED.*

IN that portion of central Germany known as the Mansfeld District, there is found a vein containing metallic ore, which is worked for copper and silver. Since, generally speaking, this ore is extremely variable in value, and since it becomes more and more a matter of immense importance to be able to judge without loss of time of the quantity of metal contained in the ore brought up from various portions of the mines, the want of good means for ascertaining this speedily was more and more felt. It need hardly be said that there exist a great many methods for the quantitative estimation of copper in its various combinations; but it is equally true that only very few of these are fit for technical application; it being moreover especially desirable that persons not professional assayers or chemists, but miners† of ordinary intelligence, should be enabled to make the required assays. In the laboratory of the mine owners at Eisleben there has been in use for the poorer copper ores a method of assaying introduced by the late H. Rose, while the raw products of the furnaces were assayed according to a Swedish method. The objection against both these methods, which were executed by fitly educated men, was, that for a large number of assays, such as are daily required to be finished there, it took too much time, too much room, and too many hands and apparatus. Rose's method just alluded to is the following: the finely powdered ore is acted on by aqua regia, to which some sulphuric acid is added; next, evaporation to dryness, dissolving in acidulated water, separation of the copper by means of sulphuretted hydrogen, and weighing the sulphide of copper after having been ignited and cooled in a current of hydrogen gas. Although the method here described is a good one, it implies for correctness the condition that no metals precipitable by sulphuretted hydrogen, and non-volatile when ignited in a current of hydrogen, be present. As regards the Mansfeld ores, the absence of such metals has been over and over again proved; but for all this, it appears that now and then small quantities of molybdenum have affected the correctness of the results. The Swedish method, however excellent its results, is very cumbrous, and embraces too many different operations to admit of being very readily and thoroughly mastered by many operators.

The difficulty as regards the Swedish method is the precipitation of the metallic copper: the solution from which it takes place, by means of metallic iron, should neither be too hot nor too cold; a too large excess of acid also is objectionable. It requires, moreover, a special tact to see when all the copper has been precipitated, since the iron must then be removed from the solution at once, and the acid solution decanted from the copper; in one word, with the greatest possible care it was not very easy to work the two methods just briefly alluded to, with operators who were not specially educated for such work.

Under these circumstances, the directors of the Mansfeld copper mines issued, in May, 1867, the following advertisement in four scientific German papers:—"A premium of 300 thalers (£45) will be granted to the party who discovers a method of assaying the Mansfeld copper ores, provided the following conditions are complied with:—(a) the assay, and all the operations belonging thereto, must not take longer time than from five to six hours; (b) one man must be enabled to execute daily eighteen assays, without too great a strain upon his

faculties; (c) the limits of accuracy, must be strictly kept within the following amounts:—for minerals containing 1 pound of copper to the hundredweight, 10 per cent; for 2 pounds to the hundredweight, 6; for 3 pounds, 5; for 4 pounds, 5; and above that figure, 4 per cent." It was moreover stated that the method to be given might be a combination of several methods already known.

Sixteen answers have been received by the directors. Six of the proposed methods were based on the volumetrical estimation of copper by means of cyanide of potassium or sulphide of sodium. One proposed method was based upon the estimation of iodine previously set free, by means of hyposulphite of soda; one titration with solution of iodine; one titration with permanganate of potassa; one titration with xanthogenate of potassa; one determination of copper as oxide; two estimations of copper as sulphide, combined with ignition in current of hydrogen gas; two a so-called process of dry assay; one a process by electrolysis.

In order to select from this material, and report upon the best and most suitable plan, a committee of three gentlemen was appointed; two of them practical assayers and copper-smelters, the third the well-known Dr. Böttger. This committee decided—

(a). That any process which included many operations, and consequently took up too much time, should be excluded.

(b). No process to be admissible which involved the use of varying quantities of ore, since it is impossible to judge by the sight about the quality of the Mansfeld ore.

(c). Any process is also inadmissible wherein, for the burning off of the bituminous organic matter of the ore, more expensive substances, as, for instance, chlorate of potassa, are recommended.

(d). Any process is likewise inadmissible whereby the reactions take place with great violence, and may thus induce explosions.

(e). Such methods are inadmissible, also, wherein, for quantities of 5 grammes and more, is recommended the treatment with acids, and evaporation to dryness after addition of sulphuric acid.

(f). On sanitary grounds, and in reference to the large number of operations and assays daily required, such processes are also inadmissible wherein hyposulphite of soda is applied so that sulphurous acid is given off; while processes wherein large bulks of sulphuretted hydrogen are used are equally discarded.

(g). Methods whereby copper is separated from the earths, oxides of iron, and other metallic oxides, either by ammonia alone or in addition thereto of carbonate of ammonia, tartaric acid, &c., are also discarded; because the precipitated oxide of iron or alumina never fails to carry down some copper also; and, also, because oxides like those of zinc, nickel, and cobalt, by remaining in solution, affect the accuracy of the estimation of copper.

(h). Such estimations of copper are also discarded whereby it is collected in a spongy state, or as sulphide upon previously dried and weighed filters.

(i). The dry assay is also discarded, as, even if it were possible to obtain therewith correct results, it would entail in the consumption of fuel, breaking up of apparatus, crucibles, &c., and the use of various fluxes, a too great expenditure.

(k). Such processes are also discarded as require in the operator too much knowledge and scientific training.

(l). Such as require the aid of assistants are also discarded.

It is clear that many parties who had entered into the competition on this subject could not, owing to the severe conditions, remain in the field. The umpires instituted a large number of assays with divers samples of ores, which had been previously analysed, and the composition of which had been determined with rigorous accuracy, but had not been communicated to them. Their researches proved that, as regards the methods of volu-

* Translated from the original German from the *Zeitschrift für Analytische Chemie Von Fresenius*, 1869, No. 1.

† Miners in Germany are all men who must have enjoyed a good education, and all are under the orders and control of scientific and practical men as their superior officers.

metric estimation, only such deserve any confidence when the copper has been first previously separated in a metallic state, is next re-dissolved, and that then only the titration method with cyanide of potassium is a fit and serviceable one.

After a long series of experiments, the umpires decided in favour of Dr. Steinbeck's method in the first place, but were at the same time so satisfied about M. C. Luckow's plan, that to that gentleman, who holds the position of chief chemist to the Cologne-Minden Railway Company at Deutz, a premium has also been awarded. It may be briefly said here, that his method is based upon the estimation of copper by electrolysis.

We will give next week full details respecting Dr. Steinbeck's method; after which, M. Luckow's will be described in full.

(To be continued).

ON THE FORMATION AND PHENOMENA OF CLOUDS.*

By J. TYNDALL, LL.D., F.R.S.

It is well known that when a receiver filled with ordinary undried air is exhausted, a cloudiness, due to the precipitation of aqueous vapour diffused in the air, is produced by the first few strokes of the pump. It is, as might be expected, possible to produce clouds in this way with the vapours of other liquids than water.

In the course of some experiments on the chemical action of light, I had frequent occasion to observe the precipitation of such clouds in the experimental tubes employed. The clouds were generated in two ways. One mode consisted in opening the passage between the filled experimental tube and the air-pump, and then simply dilating the air by working the pump. In the other, the experimental tube was connected with a vessel of suitable size, while the passage between the vessel and tube could be closed by a stopcock. The vessel was first exhausted. Turning on the cock the air rushed from the experimental tube into the vessel, the precipitation of a cloud within the tube being a consequence of the transfer.

The clouds thus precipitated differed from each other in luminous energy, which is, of course, to be referred to the different reflective energies of the particles of the clouds, which were produced by substances of very different refractive indices.

Different clouds, moreover, possess very different degrees of stability. Some melt away rapidly, while others linger for minutes in the experimental tube, resting upon its bottom as they dissolve like a heap of snow.

The clouds exhibit a difference in texture. A certain expansion is necessary to bring down the cloud. The moment before precipitation, the mass of cooling air and vapour may be regarded as divided into a number of polyhedra, the particles along the bounding surfaces of which move in opposite directions when precipitation actually sets in.

Every cloud particle has consumed a polyhedron of vapour in its formation; and it is manifest that the size of the particle must depend, not only on the size of the vapour polyhedron, but also on the relation of the density of the vapour to that of its liquid. If the vapour were light and the liquid heavy, other things being equal, the cloud-particle would be smaller than if the vapour were heavy and the liquid light.

The case of toluol may be taken as representative of a great number of others. The specific gravity of this liquid is 0.85; water being 1.0, the specific gravity of its vapour is 3.26, that of aqueous vapour being 0.6. Now, as the size of the cloud particle is directly proportional to the specific gravity of the vapour, and inversely propor-

tional to the specific gravity of the liquid, an easy calculation proves that, assuming the size of the vapour polyhedra in both cases to be the same, the size of the particle of toluol cloud must be more than six times that of the particle of aqueous cloud. Aqueous vapour is without parallel in these particulars—it is not only the lightest of all vapours, but also the lightest of all gases, except hydrogen and ammonia. To this circumstance the soft and tender beauty of the clouds of an atmosphere is mainly to be ascribed.

The sphericity of the cloud particles may be inferred from their deportment under the luminous beams. The light which they shed when spherical is continuous, but clouds may also be precipitated in solid flakes, and then the incessant sparkling of the cloud shows that its particles are plates, and not spheres. Some portions of the same cloud may be composed of spherical particles, others of flakes, the difference being at once manifested through the calmness of one portion of the cloud and the uneasiness of the other.

PROCEEDINGS OF SOCIETIES.

PHARMACEUTICAL SOCIETY.

Wednesday, April 7th, 1869.

G. W. SANDFORD, Esq., President, in the chair.

MR. HOWARD made a few remarks with reference to the cultivation of cinchona in India, dwelling more particularly on the necessity of discriminating between the embarrassing number of varieties and species now under cultivation, owing to the great variation in the amount of their respective yields. In respect to the effects of cultivation on the productiveness of the bark, it appeared that the cinchonine increased in greater proportion than the quinine.

Dr. REDWOOD read a paper in which he proposed that the question of the expediency of changing our present system of weights and measures for the metric system should be discussed. The abstract question itself was, without doubt, accepted on all sides; the only objection to be raised was a question of the balance of advantages attending its adoption and the inconveniences to be encountered in introducing it. With the public it was only a question of familiarity, and it was proposed on many sides to patch the old system rather than revolutionise and adopt a new system in its entirety. In deciding against such patchwork, and in favour of the metric system, entire dissatisfaction with the old, or unqualified approval of the new system was not expressed. It was sometimes lamented that our measures were not accurately defined on scientific principles, whereas it was asserted the standards of the metric system were so defined. This was an entirely erroneous assumption, and was only true of our system when the inch was said to be the measure of three barley-corns, the foot the length of a man's foot, &c. The metre of the metric system was not selected because it was the most useful measure, but because it was the 10-millionth part of a certain portion of the earth's surface. In basing the standard measure of our system on the vibrations of a second's pendulum, we have not sought a unit of measurement, but simply to determine the length of the inch from which all the old-established measures might be derived. Moreover, it had been found preferable to refer measures to a carefully preserved artificial standard, so that the metric system does not owe its superiority to its natural standard, but to the comparability of its divisions, which enable it to be adopted as an international system. The author also recommended that pharmaceutical chemists should be impressed with a definite notion of the integral parts of the system, not simply acquainted with its principles, and mentioned a variety of plans by which this object

* Abstract of a paper communicated to the Royal Society, January 25th, 1869.

could be attained. He considered that it would greatly facilitate matters if the names now in use in France were anglicised so as to conform more to English notions. The valuable opinions of the Master of the Mint were also quoted and discussed by the author. As a partial measure, the total abolition of troy weights had recommended itself to Dr. Graham's mind; and Dr. Redwood inferred from the general tone of his report that no sweeping change could be expected just now.

After a slight discussion, in which Dr. Attfield, Mr. Haselden, and Mr. M. Carteighe took part, it was proposed and carried, that the further discussion of the subject be adjourned; and the President announced an extraordinary meeting to be held for this purpose on Wednesday evening, May 5th.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, March 5th, 1869.

"On some further Results of Spectrum Analysis as applied to the Heavenly Bodies," by WILLIAM HUGGINS, F.R.S.

—The speaker commenced by saying that four years ago he had the honour to give in the theatre of the Royal Institution an account of the results of an attempt to apply the method of analysis by the prism, for which science is indebted to Kirchhoff, to the light of the heavenly bodies. It was the speaker's purpose to describe, on the present occasion, some of the results which had been obtained in his observatory since the spring of 1865. The peculiar suitability of spectrum analysis as a mode of investigation of the bright objects in the heavens had been confirmed, not only by the gain of further information of the chemical and physical constitution of some of these immensely distant bodies, but also by knowledge of another kind which this elegant and searching method of analysis had revealed to us.

The speaker then described the three typical forms under which all spectra may be classed, and the interpretation which our present knowledge enables us to give of these different spectra when the light is emitted by bodies rendered luminous by heat. The spectra of fluorescent and phosphorescent bodies were not to be described.

1. *A continuous spectrum without dark or bright lines* shows, as a general rule, that the luminous source is in the solid or liquid state. In certain exceptional cases, however, a gas may give a spectrum which is apparently continuous. Dr. Balfour Stewart pointed out that, as gases and vapours possess a power of general absorption, in addition to the selective absorption peculiar to each gas, a gas when luminous would emit light of all refrangibilities, producing a continuous spectrum, in addition to its spectrum of bright lines, and further that the intensity of this continuous spectrum would be in proportion to the opacity of the gas. The researches of Plücker and Frankland have shown that, under certain conditions of density and temperature, the bright lines of hydrogen expand so as to produce a spectrum which is apparently continuous.

2. *A spectrum of bright lines* indicates that the luminous body is in the state of gas. Each gas and vapour has its own set of lines. The lines may be greatly modified, or even altogether changed, under different conditions of temperature and density, as is well known in the case of nitrogen, the vapour of sulphur, and some other substances; but throughout all these changes, each gas behaves in a way peculiar to itself. There appears to be one exception to the statement that a spectrum of bright lines is peculiar to luminous gas. Bunsen found that when solid erbia is heated to incandescence, the continuous spectrum contains bright bands.

3. *A continuous spectrum interrupted by dark lines* informs us that the light has passed through vapours at a lower temperature than the source of light. As the kinds of light absorbed by each vapour correspond precisely with the set of bright lines which that vapour emits when

in the luminous state, it is possible to learn if the vapours are those of any of the substances with which we are acquainted.

The speaker said that, following the arrangement adopted in the former discourse, the most important recent information obtained of the *fixed stars* results from the application of prismatic analysis in a new direction. Under certain conditions the spectrum of a luminous body is adapted to tell us whether that body is moving towards or from the earth. The importance of information on this point will be seen from the consideration that the proper motions of the stars represent that part only of their whole motion which is transverse to the line of sight; for any motion they might have in the visual direction, toward or from the earth, would not cause any visible displacement of the star, and could not therefore be ascertained by the ordinary methods of observation.

As it is upon the length of the waves, or upon the number contained in the series that enters the eye, or falls upon the prism, in a second that a judgment is formed of the colour of the light, or its place in the spectrum is determined, it follows that any circumstance which would alter the length of the waves *relatively to the observer*, or, in other words, cause a larger number of waves to enter the eye in a second of time, would cause a change in the colour or refrangibility of the light so far as the observer is concerned. It is obvious that if the observer advances to meet the light, a longer series of waves fall upon the retina in a second of time, each wave appears shorter, and he ascribes to the light a higher refrangibility than he would do if he were not advancing to meet the light. If he were receding from the star, an alteration of refrangibility in the opposite direction would take place. The same effect would ensue if the luminous source were in motion. Thus, to a swimmer striking out from the shore, each wave appears shorter, and he passes a greater number of them in a given interval in proportion to his speed through the water.

Illustrations were given of this principle, which was first suggested in 1841, by Doppler, by means of an analogous change of pitch in sound. Two tuning-forks sounding in unison were moved rapidly towards and from the audience, when beats were heard, which told of a difference of pitch produced by the opposite motions of the forks.

As there exists beyond the visible spectrum, at both ends, a store of invisible waves, these would be advanced or degraded into visibility, in proportion as the colours of the spectrum were altered, and no change of colour would be perceived. It is therefore essential, before we can apply this method to detect the radial motion of the stars, that we know the original refrangibility of some part of the light at the moment it left the star, and also that we are able to recognise this particular part of the light again in the spectrum of the star's light. When, by means of a group of dark or bright lines, we learn the presence of a terrestrial substance in the star, both these conditions are fulfilled.

Of all the stars which the speaker had compared with terrestrial elements, when working with his distinguished friend Dr. W. A. Miller, Treas. R.S., Sirius, which contains four very strong lines which are due to hydrogen, appeared the most suitable for this investigation. The apparatus employed, and the special precautions which were taken to ensure the perfect coincidence in his instrument of the stellar line with those of the substance compared with it, were described by the speaker, who stated that, after a prolonged comparison, extending over many weeks, of the line of hydrogen in Sirius in the green, at the place of F in the solar spectrum, with the line of terrestrial hydrogen, he found that the line in the star had undergone a shift in the spectrum equal to a difference of wave length, which would correspond to a motion of recession between the star and the earth of 41 miles per second. The speaker had obtained evidence from experiment that this shift was not due to unsymmetrical ex-

pansion of the line in hydrogen as the density is increased. The greater width of this line in Sirius than in the solar spectrum would show that the hydrogen in Sirius, though at a pressure considerably less than that of our atmosphere at the surface of the earth, is more dense than the hydrogen in the solar atmosphere by which the dark line F is produced. This conclusion is in accordance with the presumably enormous mass of Sirius, as suggested by its great intrinsic splendour.

The earth at the time of observation was moving from Sirius at about 11 miles per second, which would leave 30 miles as due to the star. A further correction is required for the solar motion in space, which is believed to be towards Hercules, with a velocity of 4 or 5 miles per second. The whole of this must therefore be deducted, leaving about 26 miles as the motion of Sirius from the earth in the line of sight. The true motion of the star would consist of this radial motion compounded with the transverse motion of from 24 to 40 miles per second, which is shown by its proper motion.

The speaker then described a further examination of the nebulae (about fifty have been successfully observed) with a more powerful spectroscopic, which confirms his previous conclusion that these bodies consist mainly of the gases nitrogen and hydrogen. He also found that when the spectra of these gases are made faint by the removal of the spark to a distance, all the lines are extinguished, with the exception of the one line in each spectrum which is found in the nebulae. If such an extinction takes place in the case of the nebulae, since they are objects of sensible size, it must be attributed to a power of extinction of light existing in cosmical space.

Observations of four comets have been made. A large part of the light of these strange objects was found to be peculiar, and therefore emitted by the cometary matter. Brorsen's comet at its return in 1868, and a comet discovered by Winnecke, gave a spectrum of three bright bands. The spectrum of Winnecke's comet (comet II., 1868) was found to be identical with the spectrum of carbon as it appears when the induction spark is taken in olefiant gas, and in some other compounds of carbon. The spectrum of the comet was compared directly in the instrument with the spectrum of olefiant gas.

The speaker then described some observations of the sun. He found that while the solar lines are for the most part thickened when viewed in the light from the umbra of a spot, the lines C and F, due to hydrogen did not appear to be altered. This observation is of interest in connection with the constitution of the solar prominences as shown by the observations of the great eclipse of last August. The speaker, nearly three years ago, at the same time that he had independently made attempts to see the prominences by means of the spectroscopic, also tried the method of using absorbing media, by which the parts of the spectrum where the bright lines occur might remain, while all the rest of the spectrum was extinguished. In this way the faint prominences would be rendered visible, in consequence of the much greater relative diminution of the intensity of the illuminated screen of air, which, on ordinary occasions, conceals them from view. Recently he had succeeded in viewing the outline of these objects by means of a coloured glass combined with a spectroscopic with a wide slit. He expected to be able to view these objects by means of coloured media alone.

FRENCH ACADEMY OF SCIENCES.

Monday, April 5.

At this meeting a large number of papers were read, but the major portion does not belong to the sciences treated of in the CHEMICAL NEWS. Among those which may interest our readers, we briefly mention the following:—

A very short communication from Dr. Maumené, in respect of "*The Action of Potassium upon Dutch Liquid.*"

Many of our older readers will perhaps recollect the very sharp discussions on this subject which, a long time ago, took place between Dumas and Liebig; Maumené now proves that both those eminent *savants* were right, since the diversity of the results obtained by them is entirely due to the fact that one of them applied the liquid in excess, the other the metal.

M. GAUGAIN read a paper wherein he proves that, even with feeble galvanic currents, the electrodes are always polarised, and that this polarisation is constant when the relation between the intensity and the resistance remain constant.

M. BERTHELOT read a paper "*On the Influence of Pressure on the Reaction between Carbon and Hydrogen,*" of which paper we propose to give a full report afterwards. We intend to do the same with the paper read by MM. Schützenberger and Naudin, "*On the Acetic Acid Derivatives of the Carbo-Hydrates*"; we therefore briefly now state that, according to their researches, starch paste has to be considered as an alcohol, since it can combine with acids and form definite compounds.

M. DUBRUNFAUT made some rather unexpected statements in respect of the impurities of refined sugar, which will startle refiners as well as consumers; the learned gentleman has, however, made *beaucoup de bruit pour peu de besogne*, and has entirely ignored the series of analyses of sugar made both by means of the *saccharimètre optique*, and by very carefully executed and well-devised chemical methods by Professor Mulder, executed some years ago, which proved properly refined sugar, as ordinarily met with in commerce, to be almost chemically pure; and, after all, M. Dubrunfaut does not find anything worse than about 0.01 per cent of glucose, and a very small proportion of ash.

In order to elucidate the history of nitrification, M. HOUZEAU made a communication in reference to his experiments on the surface soil of Lower Egypt and also of the island of Noirmoutier. His results confirm Lavoisier's opinion, that nitrates are the produce of the slow combustion of certain organic substances placed under favourable circumstances.

M. FUA proposes, in order to prevent the accidents of gas explosions in coal-pits, to place along the roofs thereof platinum wires rolled up in spiral form, and to make these red-hot by means of an electric current, thus ignite cotton wicks previously steeped in molten sulphur, and, moreover, provided with a phosphorus match composition, and to set fire, by this means, to the gas always present in the pits. It need hardly be mentioned that Boussingault very properly observed thereupon that, since the accidents of this kind in coal-pits are chiefly due to sudden outbreaks of gas, and especially to a sudden variation of atmospheric pressure, this plan would not at all answer the purpose, the less so as, according to Combes, a velocity of the gas current, from 2.5 to 3 metres to the second of time, renders the safety lamps also inactive.

M. KOERNER communicated that he has succeeded in obtaining a base which is isomeric with toluidine, by bringing crystallised monobromated toluol into well-cooled strong nitric acid; he thus first obtains mononitrated bromotoluol, a sulphur-yellow coloured fluid. By treating this fluid first with tin and hydrochloric acid, and the result of this reaction next with sodium-amalgam, the new toluidine is produced; this is a colourless liquid, having about the same specific gravity as water, boiling at 198° C., and yielding, with acids, well-defined salts.

MM. DE LAIRE and GIRARD made a brief communication concerning the influence of pressure when reactions take place in closed vessels, such as sealed tubes. Among the results obtained by them we notice that increase of pressure does not favour the formation of diphenylamine; that increase of temperature, on the other hand, favours the production of that substance; while increase of pressure paralyses, so to speak, the good influence of temperature.

CORRESPONDENCE.

DISCOVERY OF THE WEIGHT OF THE AIR.

To the Editor of the Chemical News.

SIR,—You will doubtless allow me, through your medium, to reply to Mr. Rodwell. I do so by first giving the text of Aristotle, according to the most authorised editions—viz., those of Berlin, of Didot, and of Du Val in the 17th century, *Imprimerie Royale*:—

Ἐν τῇ αὐτοῦ γὰρ χώρᾳ πάντα βάρος ἔχει πλὴν πυρός, καὶ ὁ ἀήρ.

Σημεῖον δ' ὅτι ἔλκει πλεῖον ὁ πεφυσημένος ἀσκὸς τοῦ κενοῦ.

“Suo enim in loco gravitatem habent omnia præter ignem, etiam ipse aer. Cujus signum est utrem inflatum plus ponderis quam vacuum habere.”

“Dans son milieu, tout pèse, excepté le feu, y compris l'air lui-même. La preuve en est qu'une outre gonflée pèse plus que si elle était vide.”

“In their own medium, all bodies, except heat, have weight, the proof of which is that a leathern bottle weighs more when filled with air than it does when empty.”

Mr. Rodwell has asked for the original text; I give it to him with authorised translations, except, indeed, the English, in which language I have not been able to procure an edition of Aristotle. Besides, the word ἀσκός, which I find invariably in several editions is sufficient to justify the “utrem,” which is likewise found in all the Latin translations that I have seen; I might add that it is also the expression “utrem” which the majority of Latin commentators make use of.

Ptolemy, Simplicius, Seneca, and Socrates throw no light on this subject.

Ptolemy and Simplicius denied Aristotle's assertion, because they did not admit the theoretical explanation of the philosopher. Seneca might think what he pleased as to the opportuneness of the question; but because he threw jests on it, *en passant*, I do not see how they concern Aristotle. I pass on, then, to another point. Everybody admits that a leathern bottle, whether formed with a skin or consisting of a bladder, constitutes an open extensible vessel, capable, however, of being bent or flattened. Resistance to extension does not, in fact, imply absolute rigidity, and a body can cease to be extended without becoming stiff. It can also be said that a leathern bottle is very slightly extensible, without its meaning rigid. We comprehend, then, that a leathern bottle can receive compressed air; but will it resist any effort made with the intention of bursting it? It would be superfluous to show here that this is a needless fear; prepared skins are not wanting, capable of containing, at least for some length of time, air at a greater pressure than that of the atmosphere; as for the difference in weight necessary to prove it, all depends on the volume of air experimented on. Let us admit the bulk of 15 litres, which is not exorbitant, and suppose that the pressure can be increased in the interior by 15 millimetres; there might be a difference of a gramme, and from thence it would be appreciable. Mr. Rodwell reasons in the persuasion, which he seems to entertain, that Aristotle would have been obliged to swell the bladder with his own breath. But this supposition is unfounded. Long before the philosopher's time, if Homer is to be believed, the Greek smiths were acquainted with the use of bellows; and we read in the “Iliad” that more than twenty bellows were at work in Vulcan's forge for Achilles' shield. Besides, Mr. Rodwell seems to regard it as an undoubted fact that only rough and clumsy scales were in use at the period in which Aristotle lived. This is scarcely the case. If, at this time, gold was weighed with extreme care, why might they not have, I will not say balances indicating the 1-10th of a milligramme, but balances giving the decigramme, if not the centigramme. Mr. Rodwell re-

fers to Aristotle's commentators who repeated his experiment and failed in their attempt. But, as I have said before, many of the philosopher's admirers disregarded his instructions on this point—Ptolemy, Archimides, Themistius, Simplicius, and a number of others. At the same time, Averroes affirms that he succeeded, and, if I am not mistaken, he is not the only one. If Mr. Rodwell wishes, I will, a little later, point out the text; at the present moment I have not it before me. Why, then, congratulate those who did not succeed, since it is not proved that they and Aristotle must necessarily miscarry in the attempt.

Mr. Rodwell does not think that Aristotle cared much about the honour of passing for a good experimentalist; this astonishes me. Aristotle observed everything with the greatest care, and it is known that he has left little to be said on many branches of natural science, in all that was accessible to him. This is a eulogy which naturalists do not hesitate to accord him—M. Flourens, for instance, to quote only one example, in his refutation of Mr. Darwin's work.

Mr. Rodwell is not an enemy of the philosopher. It is an honour to him to render to this great man the homage of esteem which he deserves. But it is a singular way of proceeding, to contradict, *without certain proofs*, the clear and explicit word of the most exalted genius that human reason, left to its own powers, has produced. Mr. Rodwell's hypothesis does not appear to me demonstrated; and far from being the certain proof, of which I have just spoken, it remains in the state of a supposition.

Finally. My honourable contradictor will find in these lines that the versions of Aristotle which translate ἀσκός by bladder are not in the right, that there is nothing to prevent the experiment succeeding by means of a leathern bottle; also, that unless something further than what has yet been advanced is proved, it does not remain a less established truth that Aristotle affirmed the fact of the gravity of air, and that he gave, as a proof of it, an experiment which neither disinterested commentators nor actual opponents have proved to be absurd. I cannot, then, understand why Mr. Rodwell has been so eager as he has shown himself in seeking to bring my opinion to nothing. If, in my answer, anything impulsive has escaped me, I disown it, having intended to oppose Mr. Rodwell only, with the greatest esteem for his learning and the greatest courteousness towards him personally.

Such, Sir, is the answer I have thought it right to make to Mr. Rodwell; it will suffice, I hope, to make known my opinion, and to give all needful explanations to my worthy opponent.—I am, &c.,

THE ABBE A. HAMY.

Metz, March 16, 1869.

MISCELLANEOUS.

The Chemical Society.—In the report of the discussion on Mr. Chapman's paper, in our last number, Mr. Perkin's remarks were not quite clearly given, we therefore reprint them as follows:—

Mr. Perkin remarked that some time back Mr. Duppa told him that he had succeeded in obtaining the chlorides of the radicals from acetates and salts of other acids by the action of chlorine. In the case of acetates, he obtained chloride of methyl, and from succinates, the chloride of ethylene. He (Mr. Perkin) had made an examination of the chloride of methyl formed in this manner, and found that it produced the ordinary crystalline hydrate, and behaved just like the normal chloride of methyl.

The Royal Society.—Amongst the candidates for admission to the Royal Society this year, we find the names of Henry Dircks, F.C.S.; W. Esson, M.A.; Professor G. C. Foster, B.A., F.C.S.; Peter Le Neve Foster, M.A.;

J. Norman Lockyer; G. Matthey; Dr. Theophilus Redwood, F.C.S.; Cromwell F. Varley; and Dr. A. Voelcker, F.C.S. Altogether forty-five candidates are proposed, out of which fifteen are to be elected in June.

The Chair of Chemistry at Edinburgh.—On Wednesday last, at a meeting of the Curators of the University of Edinburgh, Dr. A. Crum Brown was elected to the Chair of Chemistry, in the room of Dr. Lyon Playfair, M.P., resigned.

Laboratory of the London Institution.—We learn from the *British Medical Journal* that the laboratory of the London Institution is about to be abolished. It is proposed to render the Institution more educational than heretofore; and, with this object in view, a class-room for giving elementary instruction in chemistry is to be substituted for the laboratory of research, which is at present occupied by Professor Wanklyn.

Chemical Prize.—The Chamber of Commerce of Nizza has the intention of awarding a premium of 15,000 francs (£600) to any one who discovers and invents a perfectly reliable and easily executed method of detecting an admixture of oil of grains (rape, linseed, poppyseed, &c.) with olive oil, when more than 5 per cent are present. The process must be such as to be manageable by any one, and not entail difficult or dangerous operations, and, moreover, must be perfectly reliable. The committee of the Chamber of Commerce leave all details to the inventor, but will require him to satisfy them and any scientific or practical men they may wish to consult as to the perfection of the process. Communications to be addressed before the 30th of June next to the President of the Oil of Olives Committee of the Chamber of Commerce of Nizza, Alpes Maritimes, France.—*Ann. de Chim. et Phys.*, March, 1869.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Estimation of Carbonates in Water.—(*Zeitschr. f. Anal. Chem.*, 1869.)—Chevalet estimates the entire quantity of carbonates in water by taking 200 c.c., filtering that quantity, and, after adding to it 0.5 gramme of chloride of ammonium, distilling, taking care to collect the first 100 c.c. which come over in 10 c.c. of very dilute sulphuric acid. He next estimates, acidimetrically, the sulphuric acid which has not become combined with ammonia. According to this method he found the solubility of carbonate of lime to be 0.034 gramme, and that of carbonate of magnesia to be 0.106 gramme to the litre of water. These results agree with those obtained by Dr. Hofmann and M. C. Weltzien.

Action of Saline Solutions upon Minerals.—(*Zeitschr. f. Anal. Chem.*, 1869.)—In order to find methods of immediate analysis, Mr. Fevreil has studied the simultaneous action, especially of ammoniacal salts and heat, upon a series of native carbonates. Those of baryta, strontia, and lime are readily and completely acted upon, especially if the acid of the ammoniacal salt experimented with forms in water a readily soluble combination with the carbonate. Native carbonate of magnesia is readily acted upon by all ammoniacal salts; so is also the native carbonate of protoxide of manganese; although less readily, still very unmistakably, carbonate of protoxide of iron is acted upon; with the native carbonates of zinc, lead, and copper, the same was observed.

Atomic Weight of Lanthanum.—(*Zeitschr. f. Anal. Chem.*, 1869.)—Since the determination of the atomic weight of this element has only been derived from the sulphate of baryta obtained from sulphate of lanthanum, and since it has been found that this method is incorrect, in consequence of there being carried down, with the sulphate of baryta, undecomposed sulphate of lanthanum, Dr. W. Casselmann has estimated the correct quantity of sulphuric acid which combines with oxide of lanthanum, by means of ignition. From a long series of several experiments, which agreed, he has deducted the atomic weight of lanthanum to be 45, and that of its oxide 53.

Testing Cinchona Bark.—(*Zeitschr. f. Anal. Chem.*, 1869.)—Twenty grammes of quina regia, or rubra, and 50 grammes of quina fusca are reduced to powder and intimately mixed with one-fourth of their weight of hydrate of lime; this mixture is next placed in ten times its weight of boiling alcohol of 90 per cent strength, filtered, and the residue washed with boiling alcohol. The alcoholic solution is acidified with acetic acid, next the alcohol is removed by distillation, the residue evaporated to dryness on a water-bath, re-dissolved in water containing acetic acid, again filtered, again evaporated to a small bulk, and treated with hydrate of lime. The ensuing precipi-

tate is washed with a small quantity of water, the residue dried, next treated with boiling alcohol, this solution again evaporated to dryness, and the residue weighed. The weight to be obtained from the above-named quantities should not be less, for quina rubra, than $\frac{3}{4}$ of a gramme, for quina regia and fusca not less than $\frac{1}{2}$ a gramme, provided the barks be of good quality and the operations conducted with proper care.

Action of Air upon Hypophosphorous Acid.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—According to the late G. Rose's views, hypophosphorous acid does not absorb the oxygen from the air, while, according to Würtz, hypophosphites are slowly converted into phosphites. Dr. C. Rammelsberg, in order to settle this point, neutralised some hypophosphorous acid which had been for a long time exposed to air, with carbonate of lime; on testing the salt he thus obtained, he found it gave reactions due to phosphorous acid—consequently hypophosphorous acid changes, by the action of air, into phosphorous acid.

On the Composition of Hydrated Sulphide of Zinc.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—It appears, from different researches, that the hydrated sulphide of zinc does not always possess the same physical properties, and also varies in respect of the water it retains, even after drying. According to recent researches made by M. A. Souhay, the sulphide obtained by precipitating a solution of sulphate of zinc with sulphide of ammonium retains, even after having been kept for several months over sulphuric acid, 11.37 per cent of water, which corresponds to the formula $3\text{ZnS}, 2\text{H}_2\text{O}$; dried at 100°C ., it retains 7.35 per cent of water, corresponding approximately with the formula $2\text{ZnS}, \text{H}_2\text{O}$; dried at 150°C ., it retains 4.86 per cent of water—formula, $5\text{ZnS}, \text{H}_2\text{O}$.

Preparation of Spongy Oxide of Chromium.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—Böttger recommends, for this purpose, to set fire to a mixture of 1 part of picric acid and 2 parts of bichromate of ammonia.

Preparation of Perfectly Pure Oxygen Gas.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—Böttger recommends, for this purpose, to heat permanganate of potash; it is true that this salt only yields about 10 per cent of oxygen, but it is perfectly free from chlorine, as well as from ozone. There remains, as residue, a mixture of manganate of potash and oxide of manganese, readily re-convertible into permanganate.

Action of Heat on Sulphate of Strontia.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—M. Darmstadt calls attention to the fact that sulphate of strontia obtained by double decomposition loses sulphuric acid when it is strongly ignited; moistened again with dilute sulphuric acid, it regains its primitive weight after ignition over a Bunsen burner. Boussingault proved years ago that all the sulphates of the alkaline earths lose sulphuric acid when strongly ignited.

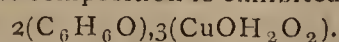
On the Preparation of Zinc-Ethyl.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—M. H. Wichelhaus has found that the coarsely-powdered zinc, obtained by passing zinc filings through a sieve, acts directly upon the iodide of ethyl, without the necessity of having the zinc alloyed with sodium. The reaction readily takes place when the apparatus containing the mixture is placed in a water-bath; the apparatus should be provided with a tube containing mercury, in order to increase the pressure; the reaction is finished in two or three hours. The result is satisfactory, and yields from 80 to 90 per cent of the theoretically-required quantity.

Composition of Sugar-Scum.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—This material, which is used as manure, is obtained in that portion of the sugar refining and sugar extraction process called *defecation*. The results of the analysis here quoted are given by M. Roussille:—Organic matter, 33.51; carbonic acid, 10.37; silica and soluble silicates, 3.42; soluble silica, 0.90; oxide of iron and alumina, 1.37; phosphoric acid, 0.46; lime, 41.40; potassa and soda, 0.04; chlorine, 0.02; sulphuric acid, 0.03; water, 7.27; loss, 1.21; total, 100.00; nitrogen, 0.446. It is almost unnecessary to observe that the composition of this material will of necessity vary in many aspects.

Researches Concerning Balsamic Modena Vinegar.—(*Bul. de la Soc. Chim.*, 1869, No. 2.)—Fausto Sestini has made some researches concerning this substance, very little, if at all known, or used, in more recent times; all the samples, five in number, submitted to analysis were more than 100 years old. The fluids are dark-coloured, exhibit an aromatic odour, possess a pleasant acid taste, are rather thickish, syrup-like, but miscible with water without becoming turbid; mixed with alcohol, however, a dark-coloured precipitate ensues. The specific gravity of these fluids varied from 1.1931 to 1.3177; the quantity of water from 42.647 to 62.270 per cent; the quantity of monohydrated acetic acid from 7.051 to 10.011 per cent; fixed acid was present at from 0.767 to 1.925 per cent; ulmin-like matter was found at from 2.072 to 5.531; other fixed non-volatile organic matter occurred at from 18.464 to 44.447 per cent; ash, at from 0.952 to 1.290 per cent. It is rather curious, that, among the substances found by the author in these fluids, glucic and apoglucic acids have been met with.

Readily Inflammable Liquid Mixture.—(*Cosmos*, April 10, 1869.)—Professor Nicklès calls attention to the fact, that when the chloride of sulphur of commerce is mixed with sulphide of carbon wherein phosphorus has been previously dissolved, a fluid is formed, which, though emitting fumes when in contact with air, is harmless, and may be for any length of time kept in well-stoppered bottles; on addition of liquid ammonia, however, or on passing into this liquid a few bubbles of ammonia gas, a most intense combustion at once ensues. This is due to the fact that the ammonia seizes upon the chloride of sulphur, forming chloride of ammonium, whereby so much heat is set free as to cause the combustion of the sulphide of carbon and phosphorus dissolved in it.

On some Molecular Combinations of Phenol.—(*Bul. de la Soc. Chim.*, 1869, No. 2.)—Professor J. Romei has repeated some experiments suggested to his mind by some made by Dr. C. Calvert on this same subject, in order to test whether Gerhardt's view of phenol, or that of the former gentleman, were correct; the question being whether the combinations of phenol with bases are true salts, or simply molecular juxtapositions of matter. Professor Romei has concluded, from his experiments, that Dr. Calvert's view is correct—that is to say, that the combinations of phenol with bases is a simple molecular juxtaposition, and not an atomic compound. Phenate of potassa may be made either by mixing together alcoholic solutions of phenol and hydrate of potassa, and evaporating until crystals are formed, or by fusing together phenol and potassa; in both instances a crystalline mass is obtained which absorbs moisture from the air, becomes gradually yellow and lastly brown, is soluble in water and alcohol, somewhat soluble in ether containing water, but almost entirely insoluble in anhydrous ether. As average result of four analyses, the following figures were obtained for 100 parts:—Phenol, 56.60; hydrated potassa, 31.30; water, 12.00—this is represented by the formula, C_6H_6O, KHO . Phenate of oxide of copper is obtained by double decomposition, by pouring a solution of sulphate of copper into a solution of phenate of potassa. The phenate thus obtained is dried over sulphuric acid; it is a green powder, soluble in acids and readily decomposed by heat; its composition is exhibited by—

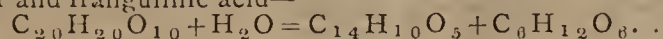


It contains 55.88 per cent of oxide of copper; the water of combination cannot be removed by heat, or otherwise, without decomposing the salt. Phenate of oxide of mercury, also obtained by double decomposition and drying over sulphuric acid, yields a compound containing 69.33 per cent of oxide of mercury—formula, C_6H_6O, HgO_2H_2 . Phenate of quinine is prepared, by double decomposition, from 8.72 parts of sulphate of quinine and 3 parts of phenate of potassa, both in alcoholic solution. After twenty-four hours' standing, the sulphate of potassa is removed by filtration, and the filtrate evaporated at a very gentle heat; very beautiful crystals are obtained nearly insoluble in ether, very soluble in alcohol and acids, but insoluble in water. On analysis, this substance yielded 76.69 per cent of quinine, while the theory requires 77.51. The author calls attention to the fact that phenate of potassa may very usefully serve for the detection of water in ether; the salt is entirely insoluble in pure and anhydrous ether, but as soon as any water is present therein, partial solution takes place, even if the ether contained only 2.50 parts of water in 1000 of ether.

On Cinnamate of Benzyl.—(*Bul. de la Soc. Chim. de Paris*, 1869, No. 2.)—From Peru balsam Frémy has obtained an oily substance named cinnamine; this material yields, when saponified, cinnamic acid. When chloride of benzyl and thoroughly dry cinnamate of soda are mixed and boiled along with alcohol, cinnamate of benzyl is formed; this substance, represented by $C_{16}H_{14}O_2$, is obtained in small pearly, scaly crystals. It melts at $39^\circ C.$, and may remain in a semi-fluid state, even at a temperature close upon $0^\circ C.$; it distils over, unchanged, in a space from which air is exhausted at between 225° and 235° ; becomes decomposed at 350° , yielding cinnamic acid and oily substances. It is very soluble in alcohol and ether; when deposited after the evaporation of that solvent, it exhibits oily drops, which slowly solidify. It is decomposed by an alcoholic solution of potassa.

On the Cause of the Hardening of Hydraulic Cement.—(*Zeitschr. f. Chem.*)—In order to test the truth of the different hypotheses made concerning this subject, A. Schulatschenko, seeing the impossibility of separating, from a mixture of silicates, each special combination thereof, repeated Fuchs's experiment, by separating the silica from 100 parts of pure soluble silicate of potassa, and, after mixing it with fifty parts of lime, and placing the mass under water, when it hardened rapidly. A similar mixture was submitted to a very high temperature, and in this case, also, a cement was made. As a third experiment, a similar mixture was heated till it was fused; after having been cooled and pulverised, the fused mass did not harden any more under water. Hence it follows that hardening does take place in cement made by the wet as well as dry process, and that the so-called over-burned cement is inactive, in consequence of its particles having suffered a physical change.

Frangulin.—(*Zeitschr. f. Chem.*, 1869, No. 1.)—The substance which, many years ago, was named rhamnoxanlin by Buchner, is obtained from the bark of the *Rhamnus frangula*, a tree growing wild in Southern Europe, by boiling it with ammoniacal water, precipitating with hydrochloric acid, and boiling the precipitate with alcohol and acetate of lead. Frangulin, $C_{20}H_{20}O_{10}$, exhibits a yellow mass having a distinctly crystalline texture, as may be seen with a lens, almost insoluble in cold water, slightly soluble in cold alcohol, and more soluble in boiling alcohol, soluble in alkaline solutions, and then exhibiting a most brilliant purplish-red colour. Its ammonia solution is at first colourless, and becomes, after a while, a brilliant red; it fuses at $226^\circ C.$, and is a very weak acid. Acids split this substance into sugar and frangulinic acid—

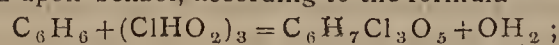


Detection of Sulphurous and Hyposulphurous Acid.—(*Zeitschr. f. Chem.*, 1869, No. 1.)—Instead of employing hydrochloric acid and zinc, Reichardt uses aluminium and hydrochloric acid. Zinc may be contaminated with sulphur compounds, while aluminium, on account of its having almost no affinity for sulphur, is always pure in this respect; the latter metal, moreover, dissolves very slowly in dilute hydrochloric acid, and therefore the same piece of aluminium may serve for many testings. Reichardt distinctly detected the sulphuretted hydrogen when a solution of one part of SO_2 in water, diluted with 500,000 parts of water, was treated with HCl and aluminium.

On Pyruvic Acid.—(*Bul. de la Soc. Chim. de Paris*, 1869, No. 2.)—MM. Ph. de Clermont and R. Silva state that they have been engaged for some time in researches on this acid, but that the results obtained are not sufficiently far advanced to enable them to speak with exactitude as to its real composition. Purified pyruvic acid, treated by bromine, becomes a crystalline mass, which was found to be bibromo-lactic acid; this acid, treated with water and evaporated in vacuo, yields a crystalline mass—another acid—the nature of which has not yet been further investigated.

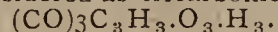
Observations on the Preparation of Strong Hydriodic Acid in Solution.—(*Bul. de la Soc. Chim. de Paris*, 1869, No. 2.)—Since this acid is becoming daily more and more used, Mr. Ferd. Vigier has studied the best mode of its preparation. It is well known that, for this purpose, a mixture of amorphous phosphorus (as first suggested by M. Personne), iodine, and water is gently heated in a tubulated retort to the beak of which a glass tube has been soldered. Vigier has found that too often, in text- and hand-books on Chemistry, a wrong proportion of the ingredients to be used is given; and after some experiments on this subject, he finds that 1 part of phosphorus, 20 parts of iodine, and 15 of water, are the best and only proper to ensure the reaction taking place; these proportions correspond to the formula, $P + 5I + 5HO = PO_5 + 5HI$.

Constitution of Phenacetic Acid, and the Transformation of Benzol into Tartaric Acid.—By L. Carius.—(*Ann. d. Chem. u. Pharm.*, vol. clix., No. 3, March, 1869.)—In a former paper, the author described two substances—trichlorophenomalic acid and phenacetic acid; the former of these is the direct product of the action of hydrate of chloric acid upon benzol, according to the formula—



Trichlorophenomalic acid.

the latter combination, however, is the result of the action of metallic oxides upon the acid just alluded to. Phenacetic acid is a tribasic acid, which may be considered as tricarbonic acid—



The author describes at great length a series of very complex combinations and reactions obtained by him while studying this acid and submitting it to divers chemical agents, and finally arrives at the result that tartaric acid may be obtained from phenacetic acid, and hence, derivatively, from benzol by the intermediate of dibromo-succinic acid.

NOTES ON LECTURE EXPERIMENTS.

Sudden Crystallisation.—I am obliged to Mr. Allen for his note respecting crystallisation, but am sorry it does not give me any information about my difficulty with respect to breakage of the flask. I have avoided the use of thick vessels in consequence of their liability to crack in preparing the supersaturated solution; and I am at a loss to understand how Mr. Allen prepares his solution in a medicine bottle. Would he kindly inform me?—CRYSTAL.

NOTES AND QUERIES.

Dutch Liquid.—Can any one please inform me of a cheap and continuous process of making quantities of Dutch liquid or olefiant gas?—JAMES LISTER.

Sand-Storm.—The *Moniteur Belge* of April 9th, mentions that at Naples, Messina, and the whole of Southern Italy, daylight, during the day of March 24th, was so obscured by the sand of the African deserts, that at Reggio and many other places lamp-light had to be resorted to as a means of enabling people to perform their daily work; the sand was carried by the south wind even as far as Turin. Professor Palmieri recognised the true nature of this sand by means of the microscope.

Action of Ammonia on Phosphorus.—Some very interesting and curious experiments on the action of ammonia on phosphorus have been published by M. Blondlot. When a piece of phosphorus is kept in strong liquid ammonia, it becomes first brownish, then green, and finally deep black. At the same time that these changes of colour occur, the phosphorus becomes hard and brittle; it cracks and splits, and ultimately falls to powder. Solar light favours this change remarkably, causing it to become manifest in several days, while in dark, more than a year is required for its accomplishment. The most concentrated ammonia produces the most rapid and decided change. The black phosphorus may be easily rubbed down to fine powder in a mortar with some water; it may then be dried on a water bath. If it retains any unchanged phosphorus which would cause its ignition, this may be removed by washing with sulphide of carbon. Passed through a fine sieve it constitutes an intensely black impalpable powder, which may be preserved under water without sensible alteration, but if exposed dry to air it slowly evolves a trace of ammonia, and, little by little, becomes yellow. In this state it resembles amorphous phosphorus in several of its chemical characters, although in some others it differs considerably, and notably in colour. The yellow powder heated in a tube to $200^\circ C.$ evolves some phosphuretted hydrogen, and passes to ordinary amorphous phosphorus; treated with ammonia, it re-assumes in the course of an hour its original black colour. Although Blondlot has not accurately determined the chemical nature of these changes, he is inclined to regard the powder as containing solid hydride of phosphorus and hydrated amorphous phosphorus.—*Pharmaceutical Journal*.

Decomposition Cell for the Oxy-Hydrogen Lantern.—A simple and convenient arrangement may be made as follows:—take two square pieces of plate glass, and also two square pieces of vulcanised india rubber, all of the same size. Cut the rubber so as to form two pieces, each of the shape \sqcup . Two platinum wires, serving as electrodes, are then placed between the two pieces of rubber, the glass plates placed one on each side of the rubber frames, and the whole fastened together by clamps at the edge. The cell I have made is 2 inches square, and the rubber $\frac{1}{8}$ of an inch thick.—C. J. WOODWARD, Midland Institute, April 13th, 1869.

New Mixture for Tempering Steel.—A locksmith at Mulhouse, named Herrenschmidt, claims to have discovered a mixture which is said to give to the commonest steel the grain and temper of the finest cast metal, and, moreover, to have the power of bringing back the original quality of steel which has been burnt. The mixture is composed as follows:—With 16 litres of distilled water mix 1 kilogramme of hydrochloric acid, 19 grms. of nitric acid (sp. gr. 1.334), 21 grms. of sulphate of zinc, and 100 grms. of tripoli. In this mixture is to be placed a piece of cast-iron of the first fusion, weighing 100 grms. When the acid mixture has acted for twenty-four hours, the composition is ready for use in the ordinary way, which, in all likelihood, means for cooling therein previously heated steel, and the composition remains effective till it is all used.—*Mining Journal*.

Detection of Diamonds.—Several of your contemporaries quote what they call a safe and easy, but after all a clumsy, method of testing the true nature of diamond, by burying it in powdered fluor spar, placed in a platinum crucible, pouring strong sulphuric acid over it, and exposing the crucible to heat on hot charcoal, with the precaution to be attended to, not to breathe the fumes. It need hardly be mentioned that since fluid hydrofluoric acid is sold in gutta-percha-made bottles, and whereas the acid thus sold is sufficiently concentrated strongly to attack any glass, even that called *strass*, generally used to imitate diamonds, there is no need whatever for performing an experiment as described, which in inexperienced hands may become dangerous. The liquid acid alluded to is quite efficient enough to test diamonds, if it is required to do so, by this means; the fluid sold also attacks native quartz.—Q.

MEETINGS FOR THE WEEK.

MONDAY, 19th.—Medical, 8.

TUESDAY, 20th.—Royal Institution, 3. Professor Grant, "On Stellar Astronomy."

WEDNESDAY, 21st.—Meteorological, 7.

THURSDAY, 22nd.—Royal Institution, 3. Professor Tyndall, "On Light."

— Royal, 8.30.

— London Institution, 6.

— Zoological, 8.30.

— Royal Society Club, 6.

FRIDAY, 23rd.—Royal Institution, 8. E. B. Tylor, Esq., "On the Survival of Savage Thought in Modern Civilisation."

— Quekett Microscopical Club, 8.

SATURDAY, 17th.—Royal Institution, 3. A. Geikie, Esq., "On the Origin of Land Surfaces."

TO CORRESPONDENTS.

Communications have been received from H. Natham; T. Hill; W. Perkin, F.R.S.; H. C. Sorby, F.R.S.; J. Lister; C. H. Osborne; A. G. Pritchard; E. T. Chapman; E. A. Erlandson; F. W. Hart; J. Spiller; D. Jefferson; H. Rich; H. Sewill; Dr. R. A. Smith, F.R.S.; T. C. Ansdell; D. Brown; R. E. Branston; J. B. Ledshaw; Dr. Röhrig; A. H. Allen (with enclosure); E. Bloom (with enclosure); S. W. Rich; B. Leeson; E. G. Tosh; Dr. Balfour Stewart; The Magnesium Metal Co. (with enclosure); and J. Heywood.

BOOKS RECEIVED.

Chemical Labels according to the latest system of Nomenclature. Compiled by H. Matthews, F.C.S., and C. W. Quin. London: H. K. Lewis.

Pocket Guide to the British Pharmacopæia.

The Hospital Pharmacopæias of London. By Peter Squire, F.L.S., &c. Second Edition. London: John Churchill and Sons.

Lessons in Elementary Chemistry, Inorganic and Organic. By Henry E. Roscoe, B.A., F.R.S. New Edition. London: Macmillan and Co.

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THE CHEMICAL NEWS.

VOL. XIX. No. 490.

ON THE CHEMICAL FORMULA OF ALIZARINE.

By EDWARD SCHUNCK, Ph.D., F.R.S., &c.

THE discovery of a mode of preparing alizarine artificially, lately made by MM. Graebe and Liebermann, and brought before the notice of the Society at its last meeting by Professor Roscoe, is not only of the highest importance from a practical point of view, but is also of great interest as being the first recorded instance of the artificial formation of a natural colouring matter. The formula to which I was led in my examination of the colouring matters of madder, viz., $C_{14}H_{10}O_4$, approaches very closely, as Professor Roscoe observed, to the one now adopted by Graebe and Liebermann, $C_{14}H_8O_4$. My formula was not founded on theoretical views but simply expressed the composition to which my numerous analyses of alizarine and its compounds conducted. I have until now seen no reason whatever to adopt any other, notwithstanding that Strecker's formula, $C_{10}H_6O_3$ has been preferred by most chemists, and was even pronounced by Laurent to be the only one possible. That my analyses do not in the least correspond with the latter formula, but are not inconsistent with that of Graebe and Liebermann, will be seen by a glance at the following numerical results of some analyses of alizarine from various sources:—

	I.	II.	III.	IV.	V.	Mean.
C	69.15	69.37	69.59	69.66	69.73	69.50
H	4.04	4.07	4.26	4.00	3.71	4.01
O	26.81	26.56	26.15	26.34	26.56	26.49

Of these analyses, I. was made with material obtained directly from madder, II. and III. with specimens derived from rubian by decomposition with acid and with ferment, IV. with alizarine from rubianic acid (its glucoside), and V. with sublimed alizarine. The three formulæ, $C_{14}H_8O_4$, $C_{14}H_{10}O_4$, and $C_{10}H_6O_3$, require the following percentages of C, H, and O.

	$C_{14}H_8O_4$.	$C_{14}H_{10}O_4$.	$C_{10}H_6O_3$.
C	70.00	69.42	68.96
H	3.33	4.13	3.45
O	26.67	26.45	27.59

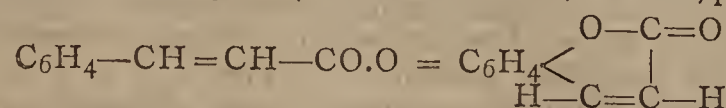
It will be seen that my results are not reconcilable with the last formula, whereas in some cases, especially in that of sublimed alizarine, the composition found agrees tolerably well with the new formula, $C_{14}H_8O_4$. The great excess of hydrogen found even in the case of well crystallised and apparently quite pure alizarine remains to be explained, and though unwilling to throw any doubt on the complete identity of the natural and artificial product, I confess I look forward with great interest to the full confirmation of this remarkable discovery.

ON THE CONSTITUTION OF COUMARIN AND COUMARIC ACID.

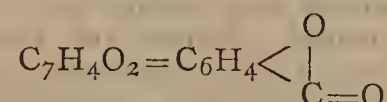
By Prof. RUDOLPH FITTIG.

AT the meeting of the Chemical Society, held April 1st, Mr. Perkin stated that my views on the constitution of coumarin could not be correct, inasmuch as coumarin has not the properties of an anhydride. I cannot consider the objections either of Mr. Perkin or of Prof. Williamson as conclusive. Coumarin certainly conducts itself in an entirely different manner from lactide and other anhydrides of the fatty series; but it does not belong to this

series; on the contrary, it is a derivative of benzol. The formula proposed by me (CHEMICAL NEWS, vol. xix., p. 3)—



shows that one of the oxygen atoms unites the third atom of carbon of the chain $CH=CH-CO$ with the benzol residue, C_6H_4 . A chain of this sort, just as all aromatic compounds, must be much more stable than similar bodies of the fatty group. But the properties of the fatty anhydrides also are not the same, the one is much more stable than the other. Acetic anhydride is suddenly decomposed by water and alcohol, succinic anhydride is not attacked by cold water, and lactide can be recrystallised from hot alcohol without decomposition. We are furthermore acquainted with an aromatic body of similar constitution, salicilide,



obtained by Gerhardt from salicylate of sodium and oxychloride of phosphorus, which shows, although not the same, still a stability very similar to that of coumarin. Boiling with water and carbonate of sodium produces no effect upon it. Ammonia acts upon it even at the boiling temperature extremely slowly. Heating with caustic potassa converts it into salicylic acid. Coumarin conducts itself in the same way. It is converted into coumaric acid even at 40–60° C., through the influence of dilute alkalies, as has been proved by Zwenger. Perkin says, "it was not an easy matter to produce coumaric acid from coumarin." This arises apparently from the fact that he used too concentrated solutions of potassa, which makes coumarin more stable, as Zwenger has already observed (*Ann. Chem. Pharm.*, Suppl., 5, 122).

The fact that coumarin occurs in plants in presence of water—in most cases together with coumaric acid (Zwenger)—can so much the less be regarded as proof, as other anhydrides occur in nature. Many resins are, as is known, such anhydrides of acids.

Concerning the negative results of Mr. Perkin in the repetition of Bertagnini's experiment on the artificial formation of cinnamic acid from the oil of bitter almonds and chloride of acetyl, I will merely mention that Kraut (*Ann. Chem. Pharm.*, 147, 111) has also repeated this experiment, and has found that the acid obtained in this way is in every respect identical with cinnamic acid. I will also add, that a short time ago, one of my pupils, Mr. Bieber, by means of the same reaction, from oil of bitter almonds and chloride of butyryle, at 130° C., prepared an acid, $C_{11}H_{12}O_2 = C_6H_5.C_4H_6.COHO$ (phenyl-angelica-acid), which is homologous with cinnamic acid, and very similar to it. It melts at 81°, is difficultly soluble in water, and gives a barium and calcium salt, which are also somewhat difficultly soluble in cold water.

Göttingen, April 16, 1869.

VEGETABLE ELECTROMOTORS.

By EDWIN SMITH, M.A.

IT is well known that a voltaic combination may be made of two liquids and a metal, if one of the three acts chemically upon one, and only one, of the other two; thus—we may employ copper, nitrate of copper, and dilute nitric acid; or platinum, potash, and nitric acid. Connect a platinum crucible with one terminal of a galvanometer, pour in a little solution of caustic potash, place in this the bowl of a tobacco-pipe having the hole stopped up with wax, pour into the bowl a little nitric acid, dip in the acid a small slip of platinum foil, and connect this with the other terminal of the galvanometer; a powerful deflection of the needle indicates the presence of an electric current, and shows its direction to be from

the alkali to the acid, the platinum serving merely as a conductor. It occurred to me, when performing this experiment, that an electro-motive combination might just as well be made of two vegetable substances, with platinum for conductor, provided only they were of a nature to act chemically upon one another—an alkaloid and an organic acid, for instance. It also seemed to me not unlikely that, wherever two flavours are habitually conjoined in our cookery and eating, the reason why they mutually improve each other is because a certain amount of electric action is set up between the substances employed to produce them. The *rationale* of the right blending of flavours might be found partly, no doubt, in chemistry, but partly, also, in galvanism.

Pursuing this idea, I tried pairs of eatables which generally go together, such as pepper and salt, coffee and sugar, almonds and raisins, and the like, and found that a voltaic current more or less strong was excited in every instance which I tested. Bitters and sweets, pungents and salts, or bitters and acids, generally appear to furnish true voltaic couples, doubtless in consequence of the mutual action of some alkaloid salt and an acid or its equivalent. As others may like to repeat or extend the experiments, I will describe shortly my mode of procedure:—Cut two pieces of platinum foil about 5 in. by 2½ in., and a number of pieces of filter-paper a trifle larger. Well-washed linen is sometimes more convenient than filter-paper. Have a small wooden board near the mercury cups of the galvanometer, and let a short copper or platinum wire, dipping into one of the cups, rest on the board. The substances to be tried must be brought to a state of solution, the stronger the better, by infusion, decoction, or otherwise. Suppose coffee and sugar are to be operated upon; solutions of both having been prepared, dip into each a slip of filter-paper; place one slip on one of the pieces of platinum foil, and the other on the second piece. Next lay the first slip and its foil on the board, with the metal touching the copper wire before mentioned. Lay the second slip with its platinum upwards, so that the coffee and sugar come into even contact with slight pressure, and immediately connect this upper slip, through a bit of copper wire, insulated from the touch, with the other terminal of the galvanometer. Deflection occurs instantaneously, and may be increased to a considerable vibration by breaking and making circuit at the right swing of the needle. After a few distinct vibrations, it is well to turn over the whole pile of slips just as they are, and connect opposite ends with the galvanometer, so as to reverse the current. This is desirable for the sake of confirming your previous observation, and of correcting any slight disturbing cause arising from the wire and mercury connectors, temperature of the hand, and so forth. It will be found that coffee and sugar have the same electrical relation to each other as zinc and platinum. Coffee, in fact, is the positive, sugar the negative element. I subjoin a table of the results of numerous experiments, conducted in the manner above described.

ELECTRO-POSITIVE.	ELECTRO-NEGATIVE.
Coffee	Sugar (loaf).
Tea (black)	"
Cocoa	"
Nutmeg	"
Cloves	"
Cinnamon	"
Mace	"
Vanilla	"
Almonds	"
Rhubarb (tincture)	"
Starch	"
Starch caramel	"
Gum caramel	"
Cane sugar caramel	"
Milk sugar	"
Gum	"
Almonds	Raisins.
Horseradish	Beetroot.
Onion	"
Horseradish	Table salt.
Mustard	"
Pepper (white)	"
Mustard	Tartaric Acid.

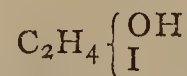
ELECTRO-POSITIVE.	ELECTRO-NEGATIVE.
Ginger	Tartaric Acid.
Cayenne pepper	"
Pepper (white)	"
Tea (black)	"
Tobacco	"
Quinine (Howard's)	"
Gentian root	"
Lemon juice	"
Horehound	"
Lavender water	"
Quassia	"
Peppermint	"
Raw potato	Lemon juice.
Rind of lemon	"
Peruvian bark	"
Camphor (tincture)	"
Laudanum	"
Arnica (tincture)	Dilute Sulphuric Acid.
Peruvian bark	"
Quinine (Howard's)	"
Iodine (tincture)	Turpentine.
Caustic potash	"
Starch	"
Starch	Iodine (tincture).
Caustic potash	Neat's-foot oil.

It is somewhat difficult to eliminate from these experiments all error arising from difference of temperature, if the galvanometer is tolerably sensitive. Care must be taken to bring the pair of solutions operated upon to the same temperature before testing them; otherwise a thermoelectric current from the hotter to the colder liquid may affect the needle, and mask the true electrical relation between the two, so far as it depends upon their chemical nature.

ON THE DERIVATIVES OF PROPANE (HYDRIDE OF PROPYL).*

By C. SCHORLEMMER.

At the time when I commenced this investigation, the existence of normal propyl alcohol was very doubtful. According to Chancel†, this body is found in the fusel oil from the marc of grapes, but Mendeleeff‡ tried in vain to isolate it from a sample of this oil which he had obtained from Chancel himself. Several attempts to prepare the normal alcohol by synthesis failed. Thus Linne-mann and Siersch|| tried to obtain it by converting acetone into propylamine, by means of hydrogen in the nascent state, and decomposing the hydrochlorate of this base with silver nitrite, but the alcohol thus formed was found to be the secondary one. The same compound was obtained by Butlerow and Ossokin§, by acting upon ethylene iodohydrine,



with zinc methyl, in order to replace iodine by methyl. Now as in both cases, according to theory, the normal or primary alcohol ought to have been formed, and as we have no explanation why instead of this compound the secondary alcohol was obtained, Butlerow and Ossokin believe that the normal propyl alcohol cannot exist. Not agreeing with this view, I was led to an investigation of this subject, the results of which I have the honour to lay before the Society.

My reasoning was as follows:—It appears, as the most probable theory, and which is now accepted by most chemists, that the four combining powers of the carbon atom have the same value. If so, only one hydrocarbon having the composition C_3H_8 can exist. This *propane* must be formed by replacing in the secondary propyl iodide, the iodine by hydrogen, and subjecting the hydrocarbon thus obtained to the action of chlorine, by which primary propyl chloride must be formed in accordance with the behaviour of other hydrocarbons of the same series.

* Read before the Royal Society, April 8th, 1869.

† *Comptes Rendus*, vol. xxxvii., p. 410.

‡ *Zeitschrift für Chemie*, 1868, p. 25.

|| *Annalen Chem. Pharm.*, vol. cxliv., p. 237.

§ *Annalen Chem. Pharm.*, vol. cxlv., p. 257.

I soon found that my theory was correct; and in a short note, which I published in *Zeitschrift für Chemie* (1868, p. 49), I stated that I had obtained the normal propyl alcohol by this method. At the same time, Fittig proved that it was contained in fusel-oils,* and lately, Linneman prepared it synthetically from ethyl-compounds by converting acetonitrile (ethyl cyanide) into propionic anhydride, and acting upon this body with nascent hydrogen†.

The propane which I used in my researches was obtained by acting upon isopropyl iodide with zinc turnings and diluted hydrochloric acid. A continuous evolution of gas takes place if the flask containing the mixture is kept cold. If it is not cooled down a violent reaction soon sets in. The gas always contains vapour of the iodide, even if it has been evolved very slowly. In order to purify it as much as possible, it was washed with Nordhausen sulphuric acid, with a mixture of nitric and sulphuric acids, and with caustic soda solution.

As a gas-holder I used a tubulated bell-jar, which was suspended in a larger inverted one, filled with a concentrated solution of common salt. When a sufficient quantity of gas had collected, chlorine was passed into it, care being taken not to have it in excess. In diffused daylight substitution products were formed, which collected as an oily layer on the salt solution. Alternately more propane and chlorine were passed into the apparatus, until it was nearly filled with the excess of propane and vapours of the most volatile substitution products. The latter were condensed by passing the gas into a receiver surrounded by a freezing mixture. To collect the liquid chlorides which were contained in the gas-holder, the tubulus of the bell-jar was closed with cork, which was provided with a wide short glass tube, open at both ends, and so much salt solution put into the gas-holder that the chlorides entered this tube, from which they could easily be removed with a pipette. By repeating this process several times, a quantity of chlorine compounds, sufficient for further investigation, was obtained. This was washed with water, dried over caustic potash, and distilled. The liquid commenced to boil at 42° C., the boiling-point rising towards the end above 200° C. By fractional distillation, a comparatively small quantity of liquid was obtained, which boiled at 42°–46°, and consisted of the primary propyl chloride, C_3H_7Cl .

0.0975 of this chloride gave 0.1730 silver chloride, and 0.005 silver, corresponding to 0.044 chlorine.

Calculated for C_3H_7Cl .	Found.
45.2 per cent Cl.	45.5 per cent Cl.

In order to prove that this body was really the normal chloride, it had to be converted into the alcohol. For this purpose I used that portion of the chlorides which, after repeated distillation, boiled below 80° C. It was heated in sealed tubes with potassium acetate and glacial acetic acid for several hours to 200° C., and thus converted into the acetate, a light colourless liquid, possessing the characteristic odour of the acetic ethers. I did not endeavour to obtain this ether in the pure state, as this could have been only effected with great loss of material, but converted it at once into the alcohol, by heating it with a diluted solution of potash, in sealed tubes, up to 120° C. After cooling, the contents of the tubes were distilled and rectified. A portion of it was oxidised with a cold dilute solution of chromic acid. No gas was evolved, but a strong smell of aldehyd was perceived, which disappeared on adding more chromic acid. On distilling to dryness, an acid liquid was obtained, which was neutralised with sodium carbonate. The solution was evaporated to dryness, and the residue distilled with a quantity of sulphuric acid, sufficient to liberate about one-fourth of the acid. The residue in the retort was again distilled with the same quantity of sulphuric acid, and, by repeating this process, the acid was obtained in four fractions. Each of these was converted into the

silver salt by boiling with silver carbonate. The silver salts crystallised from the hot saturated solution in small shining needles, which were grouped in stars and feathers. These were dried, first over sulphuric acid, afterwards in the steam-bath, and the silver determined by ignition.

			per cent.
Fraction (1)	0.2350	gave 0.1404 silver	= 59.74
" (2)	0.2420	" 0.1450 "	= 59.91
" (3)	0.1676	" 0.1002 "	= 59.78
" (4)	0.2124	" 0.1264 "	= 59.51

Mean 59.73

Silver propionate contains 59.67

I also prepared the lead-salt, which exhibited the properties of lead-propionate; it did not crystallise, but dried up to an amorphous gum-like mass. As by oxidation no other acid besides propionic was found, it follows that the alcoholic liquid could only contain normal propyl alcohol. I tried to isolate this body from the remaining liquid, by adding potassium carbonate until it separated into two layers. The upper one was taken off and dried, first over fused potassium carbonate, and afterwards over anhydrous baryta. This liquid, however, proved to be a mixture; it began to boil at 80° C., and the boiling-point rose slowly to 96° C. By fractionating, it could be separated into two portions—a smaller one boiling between 80° and 85°, and a larger one boiling above 90°. The portion boiling between 92° and 96° gave, by combustion, numbers agreeing with the composition of propyl alcohol.

0.2238 substance gave 0.4098 carbon dioxide, and 0.2675 water.

		Calculated.	Found.
C_3	.. ..	36 60.00	59.81
H_8	.. ..	8 13.33	13.28
O	.. ..	16 26.67	—
		60 100.00	

I have not yet studied the properties of this alcohol, as I hope to obtain it soon in larger quantities.

The liquid boiling between 80° and 85° appears to be an acetal; it is not acted upon by sodium, and therefore can easily be obtained free from alcohol, by distilling it over this metal. The small quantity was just sufficient for two analyses, the results of which give $C_5H_{12}O_2$ as the probable formula.

(1) 0.2500 gave 0.2725 water, and 0.5280 carbon dioxide.

(2) 0.2755 gave 0.2950 water; the determination of carbon was lost.

		Calculated.		Found.
			I.	II.
C_5	.. ..	60 57.96	57.60	—
H_{12}	.. ..	12 11.53	12.11	11.93
O_2	.. ..	32 30.78	—	—
		104 100.00		

How this body has been formed I cannot explain.

As I have already mentioned, chloride of propyl forms only a small fraction of the products obtained by subjecting propane to the action of chlorine, the chief product of the reaction being a liquid which boils at 94° to 98° C., and has the formula $C_3H_6Cl_2$.

0.1600 gave 0.3970 silver chloride, and 0.005 silver.

Calculated for $C_3H_6Cl_2$.	Found.
62.8 per cent Cl.	62.4 per cent.

This body is propylene dichloride; for its boiling point not only coincides with that of this compound, but also all its reactions are the same. Heated with potassium acetate, and acetic acid in closed tubes, it is readily decomposed, a high boiling acetate being formed, which, on heating with concentrated potash solution and distilling, yields a liquid, the last portion of which boils between 180° and 190° C., and possesses the sweet taste of propyl glycol. I did not isolate the glycol in the pure state, but proposed to establish its structure by oxidation.

A diluted cold solution of chromic acid acts violently

* *Zeitschrift f. Chemie*, 1868. p. 44.

† *Annalen Chem. Pharm.* vol. cxlviii., p. 251.

on it, carbon dioxide being evolved in abundance, and a strong odour of aldehyd being recognised, which, on further addition of the oxidising liquid, was changed into that of acetic acid. By distillation, an acid liquid was obtained, which, on boiling with silver carbonate, yielded a silver salt, which crystallised in the well-known needles of silver acetate.

0.3013 of this salt left on ignition 0.1935 silver.

Silver acetate contains
64.67 per cent Ag.

Found.
64.22 per cent.

The oxidation products (carbon dioxide and acetic acid) prove sufficiently that the structure of the glycol is expressed by the formula $\text{CH}_3\text{—CH(OH)—CH}_2\text{(OH)}$, which is that of the known propyl glycol.

The foregoing researches establish a general reaction for converting secondary compounds of the alcohols into those of primary radicals. This is effected by replacing the iodine in secondary iodides by hydrogen, and subjecting the hydrocarbons thus obtained to the action of chlorine, by which the primary chlorides are formed.

Of greater interest, perhaps, as possessing an important bearing on the theory of substitution, is the fact that the second substitution product of propane consists of propylene dichloride having the structure



This was the less to be expected, as ethane, C_2H_6 the hydrocarbon next lower in the series, yields, by acting on it with chlorine as second product, ethylidene dichloride, $\text{CH}_3\text{—CHCl}_2$. Whilst, therefore, in propane first one hydrogen atom in the methyl group is replaced by chlorine, and afterwards one which is combined with the adjoining carbon atom, in ethane the substitution takes place at one and the same carbon atom. The action of chlorine upon propane is certainly in contradiction to all theories of substitution which have been expounded.

In a second communication I propose to describe the higher chlorinated substitution products of propane.

CONTRIBUTIONS TO THE HISTORY OF EXPLOSIVE AGENTS.*

By F. A. ABEL, F.R.S., For. Sec. C. S.

THE degree of rapidity with which an explosive substance undergoes metamorphosis, as also the nature and results of such change, are, in the greater number of instances, susceptible of several modifications by variation of the circumstances under which the conditions essential to chemical change are fulfilled.

Excellent illustrations of the modes by which such modifications may be brought about are furnished by gun-cotton, which may be made to burn very slowly, almost without flame, to inflame with great rapidity but without development of great explosive force, or to exercise a violent destructive action, according as the mode of applying heat, the circumstances attending such application of heat, and the mechanical condition of the explosive agent, are modified.* The character of explosion and the mechanical force developed, within given periods, by the metamorphosis of explosive mixtures, such as gunpowder, is similarly subject to modifications; and even the most violent explosive compounds known (the mercuric and silver fulminates, and the chloride and iodide of nitrogen) behave in very different ways under the operation of heat or other disturbing influences, according to the circumstances which attend the metamorphosis of the explosive agent (*e. g.*, the position of the source of heat with reference to the mass of the substance to be exploded, or the extent of initial resistance opposed to the escape of the products of explosion).

Some new and striking illustrations have been obtained of the susceptibility to modification in explosive action possessed by these substances.

The product of the action of nitric acid upon glycerine, known as nitro-glycerine or glonoin, which bears some resemblance to chloride of nitrogen in its power of sudden explosion, requires the fulfilment of special conditions for the development of its explosive force. Its explosion by the simple application of heat can only be accomplished if the source of heat be applied, for a protracted period, in such a way that chemical decomposition is established in some portion of the mass, and is favoured by the continued application of heat to that part. Under these circumstances, the chemical change proceeds with very rapidly accelerating violence, and the sudden transformation into gaseous products of the heated portion eventually results, a transformation which is instantly communicated throughout the mass of nitroglycerine, so that confinement of the substance is not necessary to develop its full explosive force. This result can be obtained more expeditiously and with greater certainty by exposing the substance to the concussive action of a detonation produced by the ignition of a small quantity of fulminating powder, closely confined and placed in contact with, or proximity to, the nitroglycerine.

The development of the violent explosive action of nitro-glycerine, freely exposed to air, through the agency of a detonation, was regarded until recently as a peculiarity of that substance; it is now demonstrated that gun-cotton and other explosive compounds and mixtures do not necessarily require confinement for the full development of their explosive force, but that this result is attainable (and very readily in some instances, especially in the case of gun-cotton) by means similar to those applied in the case of nitroglycerine.

The manner in which a detonation operates in determining the violent explosion of gun-cotton, nitroglycerine, &c., has been made the subject of careful investigation. It is demonstrated experimentally that the result cannot be ascribed to the direct operation of the heat developed by the chemical changes of the charge of detonating material used as the exploding agent. An experimental comparison of the mechanical force exerted by different explosive compounds, and by the same compound employed in different ways, has shown that the remarkable power possessed by the explosion of small quantities of certain bodies (the mercuric- and silver-fulminates) to accomplish the detonation of gun-cotton, while comparatively very large quantities of other highly explosive agents are incapable of producing that result, is generally accounted for satisfactorily by the difference in the amount of force suddenly brought to bear in the different instances upon some portion of the mass operated upon. Most generally, therefore, the degree of facility with which the detonation of a substance will develop similar change in a neighbouring explosive substance, may be regarded as proportionate to the amount of force developed within the shortest period of time by that detonation, the latter being, in fact, analogous in its operation to that of a blow from a hammer, or of the impact of a projectile.

Several remarkable results of an exceptional character have been obtained, which indicate that the development of explosive force under the circumstances referred to is not always simple, ascribable to the sudden operation of mechanical force. These were especially observed in the course of a comparison of the conditions essential to the detonation of gun-cotton and of nitroglycerine by means of particular explosive agents (chloride of nitrogen, &c.), as well as in an examination into the effects produced upon each other by the detonation of those two substances.

The explanation offered of these exceptional results is to the effect that the vibrations attendant upon a particular explosion, if synchronous with those which would result from the explosion of a neighbouring substance in a state of high chemical tension, will by their tendency to develop

* Abstract of a paper read before the Royal Society, April, 15th, 1869.

* *Proceedings of the Royal Society*, vol. xiii., pp. 205 *et seq.*

those vibrations, either determine the explosion of that substance, or at any rate greatly aid the disturbing effect of mechanical force suddenly applied, while, in the instance of another explosion, which develops vibratory impulses of different character, the mechanical force applied through its agency has to operate with little or no aid; greater force, or a more powerful detonation, being therefore required in the latter instance to accomplish the same result.

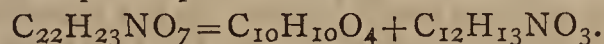
Instances of the apparently simultaneous explosion of numerous distinct and even somewhat widely separated masses of explosive substances (such as simultaneous explosions in several distinct buildings at powder-mills) do not unfrequently occur, in which the generation of a disruptive impulse by the first or initiative explosion, which is communicated with extreme rapidity to contiguous masses of the same nature, appears much more likely to be the operating cause, than that such simultaneous explosions should be brought about by the direct operation of heat and mechanical force.

A practical examination has been instituted into the influence which the explosion of gun-cotton through the agency of a detonation, exercises upon the nature of its metamorphosis, upon the character and effects of its explosion, and upon the uses to which gun-cotton is susceptible of application.

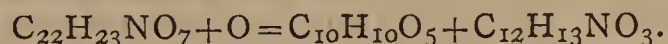
RESEARCHES INTO THE CHEMICAL CONSTITUTION OF NARCOTINE, AND OF ITS PRODUCTS OF DECOMPOSITION.*

By Prof. A. MATTHIESSEN and C. R. A. WRIGHT, B.Sc.

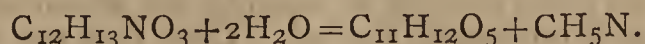
NARCOTINE submitted to the action of water, boiling either in open vessels, or at temperatures above 100° C. in sealed tubes, splits up into meconin and cotarnine,—



Narcotine heated *per se* to about 208° splits up in the same manner, but the cotarnine is at that high temperature immediately decomposed. On heating hydrochlorate of narcotine with ferric chloride, the latter is reduced, and the narcotine converted into opianic acid and cotarnine,—



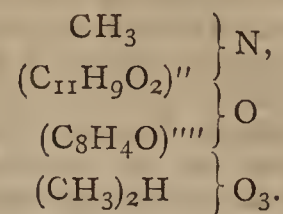
When narcotine is heated with excess of hydrochloric acid for a short time (about two hours), chloride of methyl is formed, and one atom of H substituted for CH₃ in the narcotine. If heated for some days two atoms of H are substituted for two of CH₃. When heated with fuming hydriodic acid, iodide of methyl is formed in such quantities as to prove that three atoms of H are substituted for three of CH₃. Cotarnine has for its formula C₁₂H₁₃NO₃, and is capable of crystallising with half a molecule, and with a whole molecule of water of crystallisation. Cotarnine heated with dilute nitric acids yields cotarnic acid and methylamine,—



When cotarnine is heated with strong hydrochloric acid, chloride of methyl is formed, and hydrochlorate of cotarnic acid.

Opianic acid, under the influence of nascent hydrogen, is reduced to meconin; the same acid, heated with bichromate of potash and dilute sulphuric acid, becomes oxidised to hemipinic acid. Opianic acid, heated with caustic potash, splits up into meconin and hemipinic acid. This latter acid is capable of crystallising with different amounts of water of crystallisation, crystals with half a molecule, with a whole molecule, and with two molecules of water having been obtained. All the reactions of narcotine and its products of decomposition may be

satisfactorily accounted for by the following rational formula :—



ON A NEW METHOD OF MANUFACTURING AND REFINING SUGAR.

By M. F. MARGUERITTE.

It is well known that the present method of manufacturing sugar, notwithstanding the improvements which it has received of late years, does not nearly allow of the extraction of the whole of the sugar contained in the beetroot, and that the residue contains about 50 per cent of its weight of the substance to be obtained. The combinations of baryta and lime with sugar, observed by M. Peligot, and the discovery of osmose and dialysis by Messrs. Graham and Dutrochet, have given rise to many attempts to extract from molasses the sugar which it contains in a non-crystallisable form. Some of the elements contained in molasses are already known; by examining the products of its incineration, the exact nature of the bases has been determined, and the existence of potash, lime, and soda, well established; but with regard to acids, colouring and extractive matters, little is known. The two most common methods of obtaining the organic acids are as follows:—First, to precipitate the organic salts by neutral or tribasic acetate of lead, and then to decompose the salts of lead with sulphuretted hydrogen to liberate the acid. Secondly, to treat the salts of potash with a mixture of alcohol and sulphuric acid, which forms sulphate of potash, and dissolves the displaced organic acid. The latter method, which was the one employed by us, has been pointed out by Messrs. Liebig, Gmelin, and Zeise,* for the preparation of various acids. It is simple, always efficacious, and allows of the production of the substance to be obtained without alteration, which is not always the case in the decomposition of organic salts of lead by sulphuretted hydrogen. We therefore treated some molasses with a mixture of excess of alcohol with sulphuric acid. After sufficient stirring, the molasses yielded on the one hand a considerable precipitate, and on the other a highly coloured liquid. There were discovered—

<i>In the Solution.</i>	<i>In the Precipitate.</i>
Metapectic acid	Sugar
Parapectic „	Metapectine
Lactic „	Parapectine
Malic „	Apoglucic acid
Burnt bitter principle	Sulphates of potash,
Mannite	soda, and lime†
Sundry colouring matters	

It may be seen that the alcoholic liquid, while retaining certain elements of the molasses, precipitates several products which remain mixed with the sugar and render it impure; whence it follows that this method of analysis cannot be industrially employed for extracting and purifying sugar. Nevertheless, a mixture of alcohol and different acids has more than once been proposed for the treatment of saccharine matter, and a system founded on the employment and reactions of the substances just mentioned has long since been tried, and unsuccessfully, for bleaching and purifying crude sugars.‡ Our previous

* *Annales de Poggendorff*, 1822—1825.

† Messrs. Fischman and Mendès, who have been for some time pursuing this study in my laboratory, will soon, I hope, publish the result of their researches.

‡ M. Paulet, 1837, 1838.

* Abstract of a paper sent to the Royal Society, Feb. 18th, 1869.

remarks will sufficiently explain why such a method could not succeed. Our mode of conducting the process is altogether different. Instead of precipitating the sugar by an excess of concentrated alcohol, it was suspended in solution by the use of alcohol relatively diluted (85°). Thus it was possible to filter the liquor and remove the sulphates, and most of the insoluble substances. A second volume of alcohol at 95° was then added to concentrate the medium and determine the crystallisation of the sugar. Under these conditions the mean strength of the alcohol is such that the sugar ought to crystallise immediately; however, it only settles very slowly. This temporary inertia of the sugar gives time enough to eliminate in a complete and definite manner all foreign substances, so that the sugar is finally obtained extremely pure. The alcoholic liquid, which thus contains more sugar than it can normally dissolve, assumes the condition of supersaturation.

This is a well-known phenomenon, especially since the labours of M. Gernez, and constantly occurs in saline and saccharine solutions. The condition of supersaturation being once established, it is then easy to effect a rapid crystallisation of the sugar by the addition of that substance itself in either crystals or powder. In fact, the addition of pulverised sugar to the alcoholic liquid induces, in a very short time, a total precipitation of all the sugar it contains, in the same way as the presence of crystals in syrups from manufactories and refineries, develops crystallisation, though in a much slower manner.

The alcoholimetric degree of the solution rises, the volume of added sugar increases, and in less than five hours the crystallisation is complete, whilst, in the absence of foreign crystals, it would not have terminated in eight days, or even longer. The mode of operation is as follows:—Mix, by agitation, 1 kilogramme of molasses, marking 47° Baumé in the cold, with 1 litre of alcohol at 85°, acidulated with 5 per cent. of monohydrated sulphuric acid. The liquid thus obtained is filtered, and receives the addition of 1 litre of alcohol at 95 degrees; it will then furnish, upon contact with 500 grammes of powdered sugar, an excess of 350 grammes of pure sugar,* say 35 per cent. of the weight of the molasses, or 70 per cent. of the sugar which it contains (50 per cent). The composition of the product, after being bleached with its own volume of alcohol at 95 degrees, and then dried, is as follows:—

Crystallisable sugar	.. .. .	99.50
Ash.. .. .	.. .. .	0.05
Glucose.. .. .	.. .. .	inappreciable traces.

Such is the operation, whose industrial progress and success are based on a purely scientific observation, which is here applied in a very interesting manner. About 10,000 kilogrammes of saccharine matter (molasses, third of the manufactory, last of the refineries) were treated in this manner, and gave considerable augmentations upon the normal yield, these being of course always in proportion to the actual quantity of molasses containing the product treated.

For the practical trial of this process recourse was had to the kindness of one of our friends, M. de Sourdeval, who was good enough to place at our disposal his works at Laverdines, and to aid us with his advice.

Finally, this process is applicable to all saccharine matters without exception, and presents the following advantages:—

1. The extraction of from 35 to 38 kilogrammes of sugar from 100 kilogrammes of molasses, that is, an increase upon the total yield of from 24 to 26 per 100.

2. The sugar is obtained directly and immediately, without the dissolvings, bakings, and loss, inherent to the ordinary process.

3. An almost entire suppression of bone-black in manufactories and refineries.—*Comptes Rendus.*

* By adding to the alcoholic liquid 0.006 of chloride of calcium or barium, to precipitate the last traces of the sulphates which remain dissolved, the sugar will be rendered free from sulphates and chlorides.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 15th, 1869.

Dr. A. W. WILLIAMSON, F.R.S., President, in the Chair.

WHEN the minutes of the preceding meeting had been read,

Mr. CHAPMAN said that several gentlemen had questioned him about the action of nitric ethers on acetic acid, and he supposed he must have forgotten to mention that the decomposition only occurred in the presence of concentrated sulphuric acid.

After a slight discussion, in which it was stated that the report in the CHEMICAL NEWS was correct, the words "In the presence of sulphuric acid" were ordered to be inserted in the minutes, which were then confirmed.

The certificates of the following gentlemen were read for the second time:—E. Meusel, University College; J. M. Muir, Shortland, Thames Gold Field, New Zealand; and A. W. Reinold, Merton College, Oxford.

The certificates of J. T. Bottomley, M.A., Demonstrator of Chemistry, King's College, and of F. Braby, F.G.S., were read for the third time, after which the gentlemen were balloted for, and duly elected.

Mr. CHAPMAN read a paper by himself and Mr. M. H. Smith "*On Propyl Compounds Derived from the Propylic Alcohol of Fermentation.*"

They operated on that portion of fusel oil which remained after the amylic, butylic, and ethylic alcohols had been as perfectly as possible removed. It boiled from 79° C. to 106°. It was converted into bromides, and the bromides fractionally distilled. From the mixture of bromides, the bromide of propyl is separated by fractional distillation without much labour. It is a colourless liquid, boiling at 70½° C., and of sp. gr. 1.3532 at 16° C. The alcohol was obtained from the bromide by converting it into acetate, by digestion with acetate of potash and acetic acid. The acetate so obtained was contaminated with traces of bromide, to remove which it was digested with strong ammonia, which converted the bromide into bromide of propylamine, and the acetate partially into the alcohol. The mixed alcohol and acetate were treated with caustic soda, whereby it was at once and completely converted into the alcohol.

The alcohol is a colourless liquid of strong but not oppressive odour; it boils at 97° C., and its sp. gr. is 1.8120 at 16° C. On oxidation, it yields propionic acid.

The iodide was prepared from the alcohol by digestion with excess of strong hydriodic acid; it boils at 102° to 103°, and has a sp. gr. of 1.7343 at 16° C.

The iodide and bromide yield no olefine on treatment with alcoholic potash.

Mr. CHAPMAN then read a note "*On Bromide of Amyl*" by himself and Mr. M. H. Smith.

They prepared bromide of amyl by the action of hydrobromic acid on amylic alcohol. They find the bromide has not been correctly, though variously, described. According to these observations, it is a mobile liquid, boiling at 121° C., and of sp. gr. 1.2173 at 16° C. They drew attention to the fact that the intervals between the boiling points of the bromides of methyl, ethyl, and propyl are constant, viz., about 29° C.; that between bromide of propyl and bromide of butyl is only 22°, but that the interval between the bromides of butyl and amyl is again 29°.

				Differences.
Bromide of methyl	boils at	13°	} } }	
" of ethyl	" at	42°		29
" of propyl	" at	70½°		28½
" of butyl	" at	92°		21½
" of amyl	" at	121°		29

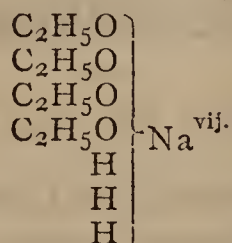
They explain this by the fact that the butyl and amyl are not normal radicals.

They express a doubt as to the possibility of obtaining pure bromide of amyl by the action of bromine and phosphorus on the alcohol.

The PRESIDENT thought the subject of the paper particularly important. Every addition to their knowledge of organic chemistry was of value. He thought that on a former occasion Mr. Chapman made a statement regarding the origin of fusel oil, when he (the President) was unfortunately absent.

Mr. CHAPMAN explained that the fusel oil in question was about twelve or thirteen years old, and was obtained at the time when there was a demand for amylene. He had operated on the lower portion.

Professor WANKLYN made a verbal communication touching the atomicity of sodium. He said that the researches which had occupied him during the last few months had tended to convince him that sodium was an eminently polyvalent element. The crystalline compound obtained by acting on excess of absolute alcohol with sodium, and which was endowed with great stability, bearing a temperature of 100° C. without alteration, had the empirical formula $C_{16}H_{23}NaO_4$. In this compound sodium appeared to be *seven-valent*, thus:—



In a great number of compounds which had been recently produced in the course of the investigation, sodium occurred in at least a three-valent state, thus:—

$Na''' \left\{ \begin{array}{c} (C_2H_4)'' \\ OH \end{array} \right\}$ Hydrated oxide of ethylene-sodium (or absolute ethylate of sodium).

$Na''' \left\{ \begin{array}{c} (C_2H_4)'' \\ [O(C_2H_3O)]' \end{array} \right\}$ Acetate of ethylene-sodium.

$Na''' \left\{ \begin{array}{c} (C_2H_4)'' \\ [O(C_5H_9O)]' \end{array} \right\}$ Valerianate of ditto.

$Na''' \left\{ \begin{array}{c} (C_2H_4)'' \\ [O(C_7H_5O)]' \end{array} \right\}$ Benzoate of ditto.

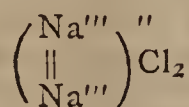
$Na''' \left\{ \begin{array}{c} OC_2H_5 \\ H \\ Cl \end{array} \right\}$ Compound got by treating hydrated oxide of ethylene-sodium with HCl.

$Na''' \left\{ \begin{array}{c} OC_2H_5 \\ C_2H_3O \\ Cl \end{array} \right\}$ Compound got with chloride of acetyl.

$Na''' \left\{ \begin{array}{c} OC_2H_5 \\ H \\ SH \end{array} \right\}$ Compound got with H_2S .

Many other such compounds can doubtless be produced, inasmuch as the hydrated oxide of ethylene-sodium manifests this tendency of combining with so many various reagents.

The common sodium compounds are regarded by Professor Wanklyn as being not, properly speaking, compounds in which sodium is mono-valent, but complex compounds, thus:—

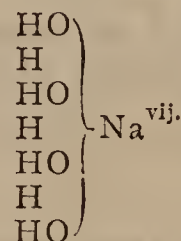


is common salt.

The PRESIDENT remarked that the question of the equivalent value of elements was one in which there was, at present, room for difference of opinion. Mr. Wanklyn's views were likely to be useful if followed up by himself and other members, so as to come to a distinct and definite decision. He thought that in many parts of their progress in science, they attended too exclusively to one particular order of phenomena, without comparing their conclusions with other parts of science. Until they obtained a com-

pound of sodium with three monads, they must have some hesitation in assigning to it, as a general principle, the classification of triad functions. At the same time, it seemed to him quite natural to suppose that a monad, such as sodium usually appeared to be, might, in certain cases, act as a triad. But it was a question whether it was more in accordance with its general behaviour to assign to it those functions which it appeared, in exceptional cases, to assume; or to say that sodium was a monad, and to explain the exceptional cases by the special hypothesis which seemed to suit them best. Mr. Wanklyn was probably aware that many of them might be represented as a monad to sodium. Sodium, combining with three of acetylene, seemed to favour Mr. Wanklyn's view; but when they had three times that group—acetylene, two carbon, and one oxygen, a union amongst those elements themselves might be conceived, forming a radical which might itself be monadic, and that circumstance was the difficulty in organic bodies. He (the President) thought that organic bodies must generally obey those principles, which were clearly established among mineral compounds.

Mr. VERNON HARCOURT could not understand why it was more natural to suppose that the combination of those molecules of alcohol which had been regarded as a molecule of sodium and alcohol should not be rather analogous to the water of crystallisation with any hydrate or any other salt. In the instance before them they had, besides sodium hydrate, other combinations of the sodium hydrate; when the solution was evaporated, they obtained crystals—he did not remember whether they contained three molecules of water of crystallisation, but, following Mr. Wanklyn's formulæ, he would write them thus:—



Supposing that the crystals contained three molecules of water of crystallisation, there would be a compound similar to that of the new sodium alcohol, which would furnish an argument, and a very weak one, for regarding the sodium as being heptatomic.

Professor WANKLYN regarded the combination of salts with their water of crystallisation as real compounds. If a great deal of maltreatment was necessary to break up the hydrate of sodium, he would consider the combination as good a chemical compound as any he knew. If a compound, containing the elements of alcohol and chloride of sodium, were admitted to be a genuine chemical compound, and if the ordinary values were assigned to the carbon, oxygen, and chlorine, could it be expressed otherwise than by writing sodium as triatomic? With regard to the ordinary sodium compounds, he considered that the sodium was merely complex sodium, or diatomic.

A slight discussion ensued between Dr. Debus and Mr. Wanklyn as to water of crystallisation, &c., of compounds, after which

Mr. CHAPMAN said that unless they were prepared to abandon the atomicity theory, they must admit that when two compounds unite, they have a bond with which to hold themselves together. If they had a certain compound of chloride of sodium with anything else, he thought that they had nearly perfect proof that either chlorine or sodium—most probably both—were not monads; otherwise there was no reason why the compound should hold together. It could only enter into combination with another body if that body was diatomic, and then only by splitting up into its elements in doing so.

After some further remarks by Dr. Debus, Mr. Chapman, and Mr. Newlands.

The PRESIDENT said it was very important to know what was meant by *atomicity* in contradistinction to

equivalence. He thought the words had received a very distinct definition, which really ought to be adhered to. The only difference he knew in the consistent use of the word was, that atomicity was a real or untrue kind of equivalent which was rigid, absolute, and unchangeable. They had used the word in a very different sense that evening, and he thought in one that ought to be conveyed by the word *equivalence*. Introducing such words as *bonds* he believed quite unnecessary, because a "bond" was a physical image, and nothing whatever could be expressed by that word which could not be expressed without it. The habitual use of such a word must be productive of very considerable injury to the theoretical habits of those who used it. He would not express any opinion as to whether the atomicity theory was right or the equivalence theory, but they were different. For his own part, he thought the rule was to find that elements were capable, under different conditions, of assuming different equivalence of value; but it was, he thought, going a little further than the fact, to say they must all be capable of that; the common case was that elements changed their equivalent value, and it was reasonable to suppose they all did so, and by increments of two.

The Society then adjourned.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, April 6th, 1869.

E. W. BINNEY, F.R.S., F.G.S., Vice-President, in the Chair.

Dr. JOULE, F.R.S., gave an account of his endeavours to improve the instrument known as the *dip circle*.

A paper was read "*On the Chemical Formula of Alizarine*," by EDWARD SCHUNCK, Ph.D., F.R.S., &c. (See page 193).

FRENCH ACADEMY OF SCIENCES.

Monday, April 12th, 1869.

THE first paper read at this meeting, was one on the "*Synthesis of a New Butylen—the Ethyl-Vinyl*," by M. Ad. Wurtz.

This substance may be obtained by two entirely distinct methods; either by suffering the iodides of the alcohol radicals to act upon sodium, or by making the alcoholic bromides react upon zinc ethyl. By the first method, the author obtained methyl-allyl; by the second, the vinyl-ethyl has been obtained. This is, at ordinary temperature, a gas, but becomes a liquid at -5°C . With bromine, it forms a bromide, boiling at 166° . Submitted to the action of hydriodic acid, and heated in a sealed tube, a liquid is obtained which is very similar to iodide of butyl, boiling, as the latter does, at 121° . The specific gravity of this iodide of ethyl-vinyl is 1.634; it differs from the iodide of butyl by its behaviour with acetate of silver, in contact with which the iodide of ethyl-vinyl is decomposed, forming an acetate, boiling at 110°C .

The author does not, for the present, desire to enter into further details, which he reserves, after having more accurately studied the origin of this substance.

Methyl-allyl boils at about 159°C ., and has, at 0°C ., a specific gravity of 1.8299.

The other papers read do not belong to the domain of sciences treated in our paper.

We read, however, under the same heading as above, in *Cosmos*, something which may find conveniently a place here. It appears that the well-known Swiss *savant*, De la Rive, is at present at Paris, and engaged in studying the propagation of electricity in gas and rarefied vapours. His assistant, Dr. Sarrazin, has noticed some hitherto un-

known phenomena of phosphorescence. As soon as pure oxygen is reduced to a pressure of only two millimetres or less, it becomes exceedingly luminous under the influence of electricity. No other known gas is possessed of this property. All compound gases which contain oxygen become also luminous, and most so the protoxide of nitrogen. The Doctor has found that the cause of this phosphorescence is due to the formation of ozone, since it does not take place when, previous to passing an electric current through the gas, powdered metallic silver has been introduced into the space containing the gas, but the silver becomes rapidly oxidised.

While engaged in studying the part which sulphuric acid plays in these phenomena, Dr. Sarrazin found that when a small quantity of this acid, which is considered non-volatile at ordinary temperatures, was confined along with nitrogen gas, for instance, in a gas jar, and an electric current passed through, a very intense luminosity was caused, notwithstanding nitrogen is not by itself rendered luminous under these conditions. The author found that there was decomposition of sulphuric acid, with formation of ozone, and that the phenomena ceased when powdered silver was introduced.

CORRESPONDENCE.

ON SOLUTIONS OF GLAUBER'S SALT.

To the Editor of the Chemical News.

SIR,—Your correspondent "Crystal" has written twice to ask for instructions how to prepare, for a lecture experiment on sudden crystallisation, a supersaturated solution of Glauber's salt without breaking the flask.

It is easy to do this if the heat be properly managed.

The salt parts with its ten atoms of water of crystallisation with so much ease, that if the heat be too suddenly applied, the anhydrous salt is thrown down in the form of a fine powder, which makes the flask bump, or causes it to crack, by fusing and by preventing convective currents. When once the anhydrous salt begins to form, the evil is increased by raising the temperature, for by this means its solubility is diminished.

As the ordinary solution of this salt is one of the anhydrous, and not of the 10-atom or of the 7-atom variety, attention must be paid to the point at which the ordinary 10-atom salt fuses in its water of crystallisation; that is, the point at which the anhydrous salt dissolves in the 10 atoms of water that accompany the ordinary salt. It does so at about 93°F . Now, in making a solution of six, five, or four parts salt to one of water, the flask containing one of these proportions should be gently heated with constant agitation over a spirit lamp, or other source of heat, or in a water bath not over 100° , so that the contents of the flask may not much exceed 93° , or from that to 98° . Under these conditions, the salt will quietly melt down into a clear solution, which may be then left to boil. The boiling may be greatly facilitated by the addition of some fragments of cocoa-nut shell charcoal, or even of a lump of coke or of pumice stone; but the charcoal is the best, on account of its superior density.

The boiling solution should be filtered into tubes, flasks, or bottles, made chemically clean by washing in caustic alkali, or sulphuric acid, spirit of wine, &c., and rinsing. The tubes, &c., may stand in hot water while being filled; or when filled, they may be passed over the source of heat, so as to raise them to near the boiling point before being plugged with cotton wool.

Such solutions may be kept for a length of time, clear and bright, without any change. On taking out the cotton wool, crystallisation sets in from the surface, and proceeds rapidly downwards, converting the whole into a solid mass, so that the vessel may be inverted without any escape of liquid.

I think it is a loss to the lecture table that solutions of this salt are confined to the single illustration of sudden crystallisation; whereas a whole lecture might be profitably devoted to the consideration of this salt, as it respects the phenomena of supersaturation and the action of nuclei.

Did your space permit, I would write such a lecture; but I can only point out briefly a few experiments.

1. Put a tube, containing a cold but highly supersaturated solution, into a freezing mixture at 20° to 30° F.; in a few seconds, well-shaped octahedral crystals of the anhydrous salt will begin to descend. The tube may now be wiped and exhibited at the lantern, or handed about.

2. If the neck of a large flask be slipped over the neck of one of the flasks containing the boiling filtered solution, and this be set aside in a cold place for many hours, there will be found at the bottom of the flask crystals of the modified 7-atom salt (four-sided prisms, with a rhombic base). They should be bright and transparent. On inverting the flasks, the mother liquor may be discharged into the empty flask. If this be not clean, the liquor will become quite solid; but, with care (warming the neck of the smaller flask is a good plan), the crystals can be disengaged from the supersaturated mother liquor, and left to drain. If the crystals of the 7-atom salt be touched with a bit of wire or other solid, the point touched immediately becomes opaque, and the opacity spreads in all directions, until the whole mass becomes like the boiled white of egg.

3. Before closing one of the tubes with cotton wool, touch the inner surface at one spot with the finger slightly greasy. When the tube is cold, it may be inclined so as to bring the solution into contact with various parts of the glass: the clean portions have no effect; but the moment the solution touches the edge of the finger mark, crystallisation sets in.

4. If the solution be filtered into a stoppered bottle, and the bottle be closed and tied over, and shaken so as to wet every part, it may be left to cool. When cold, the bottle may be violently shaken; and the air, though long in separating, does not act a nucleus. On loosening the stopper, air streams in, and drags in a particle of dust, which immediately acts as a nucleus.

5. Solids, whether porous or compact, boiled up with the filtered solution, are inactive when the solution is cold. So, also, is a glass rod, &c., made chemically clean. Or a metal or glass rod, passed through the plug, held in the boiling steam, and left suspended in the flask, is inactive when the solution is cold. Such a rod may become covered with a crystalline crust of the salt, and even this is not a nucleus.

6. A striking way of showing the sudden crystallisation of the salt is to boil a filtered solution in a flask, put the flask on a plate, and cover this with a bell jar. It may be left for weeks in this state without crystallising; but the moment after the bell glass has been lifted off the solution becomes solid.

7. If vessels with necks of different diameters be opened, the solutions are long in crystallising in proportion as the diameters are small. In vessels with very narrow necks, the solutions may not crystallise at all until a nucleus be inserted.

8. Faraday, in one of his juvenile lectures, gave some idea of the heat liberated during the crystallisation, by emptying a flask upon the bulb of a large spirit thermometer. The temperature commonly rises to about 85° F.; but the best salt for showing this effect in a lecture experiment is the sodic acetate. It is easy to show a rise from 10° to 105° F.

Many other experiments might be shown, such as the easy fusibility of the 7-atom salt, the milky appearance when the chilled solution is shaken, the varied action of nuclei, &c.; but these and other illustrations will naturally occur to any one who is going to give a physical lecture on Glauber's salt.—I am, &c.,

C. TOMLINSON.

Highgate, N., April 19th, 1869.

JARGONIA.

To the Editor of the Chemical News.

SIR,—As some question has arisen about what Mr. Sorby has done, I think it might be well to give extracts from two of the letters received from that gentleman, during our long correspondence relative to a recent paper* in the *Proceedings of the Royal Society*.

"Sept. 30th, 1868.

"I forget whether I told you that I had discovered the most remarkable spectrum that probably anyone ever saw, in a zircon from Ceylon. It is quite unlike anything previously seen. It contains about a dozen absorption bands, which are not mere shades, like what is generally seen in solid bodies, but in narrow perfectly black lines, like those seen in the spectra of coloured gases. It is not due to zirconia, because some zircons show no trace of such a spectrum. As far as I can make out, the lines are not due to any substance known to produce absorption bands. So far, it is a complete puzzle, and I am half inclined to believe that it may turn out to be due to some unknown element. Unfortunately the amount of material at disposal is far too small to admit of analysis, and curiously enough, it does not give any bands when melted with borax, but only a colourless bead. I may say that the mineral which gives this wonderful spectrum is nearly colourless, and becomes almost absolutely so when reheated, and remains colourless, but gives the same wonderful bands, when cold."

"Oct. 23rd, 1868.

"I have been led into a long series of work by the probable new substance. I am endeavouring to determine the spectra of all known elementary substances when combined with silica. There are only a very few that I have not been able to study, and hope to be able in time. So far as I see, no known substance would give the spectrum of the jargon I named.

"I have since examined a number of jargons and other zircons. There does not seem to be a trace of the new substance in any except those from Ceylon, and most of these only contain a small quantity, in comparison with the very remarkable specimen which must contain so much.

"I do not know if I told you that I suspect the existence of a second new substance. I may be wrong in both cases; but it seems difficult to draw any other conclusion from the facts at present known."—I am, &c.,

P. J. BUTLER.

55, De Beauvoir Road, N.
April 19th. 1869.

MISCELLANEOUS.

COMPLIMENTARY DINNER TO DR. ODLING.

On the evening of Tuesday last, April 20th, a number of gentlemen who have been associated with Dr. Odling as past and present members of the Council of the Chemical Society in the thirteen years during which he has filled the office of Secretary, entertained the Doctor at a complimentary banquet, at the Albion Tavern, Aldersgate Street. The chair was occupied by Dr. Warren De La Rue, F.R.S., V.P.C.S., who was supported right and left by Dr. Odling, F.R.S., Dr. Tyndall, F.R.S., Professor Williamson, F.R.S. (Pres. C. S.), Sir Benjamin C. Brodie, Bart., F.R.S., &c., &c. The following is a list of those who took part in the entertainment:—Messrs. F. A. Abel, F.R.S.; E. Atkinson; J. Anderson, M.D.; J. Lowthian Bell; G. B. Buckton, F.R.S.; F. C. Calvert, F.R.S.; D. Campbell; A. H. Church, M.A.; W. Crookes, F.R.S.; H. Debus, Ph.D., F.R.S.; F. Field, F.R.S.; D. Forbes, F.R.S.; G.

* "On the Structure of Rubies, Sapphires, Diamonds, and some other Minerals," vol. xvii., pp. 291—302.

C. Foster; J. H. Gilbert, Ph.D., F.R.S.; J. H. Gladstone, Ph.D., F.R.S.; D. Hanbury, F.R.S.; A. V. Harcourt, F.R.S.; C. Heisch; H. Letheby, M.A., M.B.; G. D. Longstaff, M.D.; N. S. Maskelyne, M.A.; A. Matthiessen, Ph.D., F.R.S.; G. H. Makins; E. J. Mills; Hugo Müller, Ph.D., F.R.S.; W. Marcet, M.D., F.R.S.; E. C. Nicholson; H. M. Noad, M.D., F.R.S.; W. H. Perkin, F.R.S.; D. S. Price, Ph.D.; A. P. Price, Ph.D.; T. Redwood, Ph.D.; W. J. Russell, Ph.D.; J. Denham Smith; A. Smee, F.R.S.; J. A. Voelcker, Ph.D.; H. Watts, B.A., F.R.S.; J. Williams; J. T. Way; and J. A. Wanklyn. Letters expressing regret at being unable to attend were read from E. Frankland, Ph.D., F.R.S.; T. Graham, D.C.L., F.R.S.; A. W. Hofmann, Ph.D., LL.D., F.R.S.; H. Bence Jones, M.D., F.R.S.; J. B. Lawes, F.R.S.; W. A. Miller, M.D., LL.D., V.P.R.S.; Lyon Playfair, C.B., M.P., Ph.D., F.R.S.; H. E. Roscoe, B.A., Ph.D., F.R.S.; R. Angus Smith, Ph.D., F.R.S.; E. Schunck, Ph.D., F.R.S.; J. Stenhouse, LL.D., F.R.S.; and Col. P. Yorke, F.R.S. After the usual loyal toasts, the Chairman proposed, in eloquent and appropriate terms, the toast of the evening, "The Health of Dr. Odling;" and drew attention to a handsome silver tankard, which had been presented by some of those present, appropriately inscribed, for Dr. Odling's acceptance, as a memento of this day. After this had been filled with an "ethylic compound of complex composition and high saturating power," as the Chairman aptly described it, and had been passed round as a loving cup to all present, it was presented to the Doctor. The Chairman concluded his able speech amid loud and continued applause; and the toast was drunk upstanding, amidst enthusiastic cheers. Dr. Odling replied in feeling and impressive words, in which he spoke of the great advantage and pleasure it had been to him to form the acquaintance of those distinguished men who had filled the Presidential chair, during the thirteen years in which he had occupied the Secretaryship of the Chemical Society. Appropriate speeches were afterwards made by Professor Williamson, as President of the Chemical Society; Professor Tyndall, on behalf of the visitors; Sir Benjamin Brodie, Bart., Messrs. Harcourt, Perkin, and Dr. H. Müller, as Secretaries; Professor Abel, Dr. Gladstone, Dr. Longstaff, Professor Anderson, and others. In the intervals between the speeches, Professor Abel performed a selection of operatic music on the piano, and songs, comic and otherwise, were sung by Mr. F. Field, and also by Col. Boxer, Captain Goodenough, Col. De La Rue, and Mr. J. C. Brough, who were present as guests. Great credit is due to Messrs. Abel, Müller, and Nicholson, who formed the executive committee, for the admirable manner in which everything was organised.

Death of Professor Nicklès.—We learn from a short notice in the *Moniteur Belge* of the 14th inst. that Professor Nicklès, of the Faculty of Sciences of Nancy, Département de la Meurthe, France, has died suddenly, in consequence of accidentally inhaling, as it appears, the vapour of concentrated hydrofluoric acid, while engaged in making experiments to isolate fluorine. The deceased was born at Erstein (Bas-Rhin) on the 30th of October, 1820, was appointed in 1854 to the Professorship he held, and in 1857 was made corresponding member of the Council General of Public Instruction. The printed list of his many and valuable published scientific works occupies a complete page in the well known *Biographisch-Literarisches Handwörterbuch zur Geschichte der exacten Wissenschaften*.

Gold Discovery in Uist.—According to rumours current in Shetland, the Lerwick correspondent of the *Scotsman* writes:—"It seems that gold has been discovered in Uist: it is said to exist in two localities, but whether it will pay for working has not been determined yet. There are two islands named Uist, one named North and the other South; both are situated off the Western Coast of Scotland's mainland, and belonging to the Hebridean Group of Isles.

Atomic Weights.—We observe, and have read with great pleasure, a brief, but, at the same time, very clearly and highly finished paper on this subject in Spon's "Dictionary of Engineering." This paper, written as it evidently is, by a highly accomplished scholar and mathematician, as well as scientific chemist, deserves not only to be read and used by engineers, but will undoubtedly prove very acceptable to many chemists, and especially to students of chemistry, who will find in about eight octavo pages the whole doctrine of Stoichiometry fully, clearly, and comprehensibly explained. The paper alluded to occurs in Nos. 6 and 7 of the work, each part of which may be had separately.

Applied Science in Italy.—We have to acknowledge the receipt of two small papers from M. Emile Kopp, viz., two printed copies of decrees of H. M. the King of Italy, officially published, one dated the 30th of December, 1866, the other the 14th of November, 1867. The former relates to a reorganisation of the Royal Italian Museum, which is a kind of polytechnic school and agricultural college combined. From the different schedules added to this decree, it appears that a very well selected and comprehensive course of lectures is ordered and intended to be given. The latter decree relates to the approval by His Majesty of the regulations made by the Italian Secretary of State for Public Instruction for the Royal School of Applied Science and Engineering at Turin. We have to confess that, looking over the *series lectionum*, nothing of this kind of instruction, or anything approaching to it established by the State, is to be found in the United Kingdom. No doubt the Italians will, as we hope, highly appreciate the excellent opportunities given them at a very trifling cost, to obtain that practical and scientific instruction they are highly in want of, in order to be enabled to fully develop the eminent natural resources of their beautiful country, once the chief seat and depository of learning, art, and science in the world.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Synthesis of Alizarine.—(*Moniteur Scientifique*, No. 296, April 15th, 1869.)—For a number of years past many scientific chemists have tried to obtain alizarine by artificial means. In the year 1861, M. Roussin thought he had succeeded, by withdrawing from binitronaphthalene, $C_{10}H_8(NO_2)_2$, two equivalents of oxygen, and by converting at the same time the nitrogen into ammonia. Although this experiment was unsuccessful, it has no doubt been made the starting point for the very important solution of this problem, which MM. Graebe and Liebermann, at Berlin, have just brought to a highly successful issue. The two last-named gentlemen found that when alizarine obtained from madder-root was acted upon by powdered zinc, a hydrocarbon was generated, which, instead of naphthalene, proved to be paranaphthalene, which, according to the researches of MM. Anderson, Fritzsche, Limpricht, and Berthelot, has the following formula:— $C_{14}H_{10}$; accordingly, MM. Graebe and Liebermann consider that the formula for alizarine should be $C_{14}H_8O_4$. It will be observed that this formula differs from that of paranaphthalene only by having two atoms, four equivalents of oxygen more, and two of hydrogen less, than that of paranaphthalene. The process of transformation of paranaphthalene into alizarine consists of three operations:—First, the paranaphthalene, also named anthracen, $C_{14}H_8$, is converted into anthraquinone, $C_{14}H_8O_2$, which is done by either heating one part of anthracen with two parts of bichromate of potassa and sulphuric acid, or by heating the anthracen with bichromate of potassa and anhydrous acetic acid; the anthraquinone thus obtained is first washed with water crystallised from alcohol or benzol, and so purified constitutes a yellow-coloured solid, crystallising in needles. The second portion of the process consists in substituting, for two atoms of hydrogen, two of bromine in the anthraquinone—in other words, the preparation of bibromanthraquinone—



Two methods may be followed for this operation—either by heating, without simultaneously applying pressure, the anthraquinone with bromine, at temperatures varying between 80° to 130° C.; or, without first preparing anthraquinone, by making the bromine act directly upon the anthracen, thus producing quadribromide of anthracen—

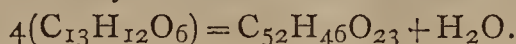


The quadribromide (first discovered by Anderson) thus produced is next oxidised by any of the two methods above described, and then

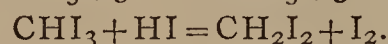
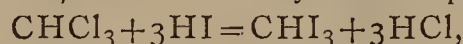
bibromanthraquinone is obtained; if preferred, chlorine may be substituted for bromine. The third part of the process is the conversion of the bibromanthraquinone into alizarine; for this purpose it is heated, at from 130° to 260° C., with a solution of caustic potassa or soda; a blue colour is produced, which becomes more and more deep at first; when the deepening of the colour ceases, the operation is finished. After cooling, the saline mass is treated with water, the solutions are filtered, an acid is added in excess, and a yellow precipitate ensues, which is the alizarine, or lizaric acid; this, after washing with water and gently drying, is fit for use, and is in all respects identical with that naturally produced in the madder root.

On the Substitution of Graphite by Antimony in Galvanic Batteries.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—According to Böttger, the following arrangement is preferable, as regards force and durability, to either Daniell, Minotto, or Leclanche's batteries. A cylinder of amalgamated zinc is placed in a concentrated solution of equal parts of common salt and sulphate of magnesia; the antimony is placed in a porous cell filled with dilute sulphuric acid.

Abietite (*Les Mondes*) is a substance discovered by Rochleder in the needle-like leaves of the *Abies pectinata*; in many aspects it resembles mannite, from which it differs by its solubility and composition, which may be represented by $C_6H_8O_3$. The said leaves also contain a soluble tannin, $C_{13}H_{12}O_6$, which, by losing oxygen and hydrogen, is readily transformed into an insoluble modification—



Action of Hydriodic Acid on Organic Chlorides.—(*Les Mondes*.)—According to A. Lieben, the chlorides of ethyl, butyl, and amyl, and also other chlorinated organic compounds, when heated in sealed tubes with hydriodic acid, are converted into the corresponding iodides without any disengagement of gas. In order to discover whether, perhaps, there were actions of mass in play, the author has reversed the experiment, by treating iodide of ethyl at 130° C. in a sealed tube with hydrochloric acid; there was only a slight trace of chloride of ethyl formed. When chloroform is heated for seven hours consecutively with eleven times its weight of hydriodic acid at 127° in a sealed tube, there is formed hydro-iodoform, iodide of methylene, hydrochloric acid, and free iodine; this reaction may be thus represented:—



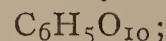
Some Varieties of Roccella Tinctoria.—J. Stenhouse.—(*Ann. d. Chem. u. Pharm.*, vol. 159, No. 3, March, 1869.)—The most interesting portion of this rather long paper is undoubtedly an improved method for the estimation of the quantity of colouring matter contained in these and similar kinds of lichens. For this purpose, 100 grains of the lichens are to be digested with a dilute solution of caustic soda; this operation should be repeated, in order to make sure of extracting all useful matter. The fluid so obtained is filtered; after filtration it is treated with a solution of hypochlorite of soda of known strength, the addition of which solution produces a blood-red colouration of the fluid, and this continues as long as any colouring matter is left. From the quantity of *eau de javelle* used the quantity of colouring matter may be inferred.

Kyaphenin.—By C. Engler.—(*Ann. d. Chem. u. Pharm.*, vol. 159, No. 3, March, 1869.)—When treating benzo-nitrile with bromine, the author obtained a substance which proved to be identical with that obtained by Cloez on treating chlorobenzoyl with cyanate of potassa. Cloez considers kyaphenin as trio-benzo-nitrile, in consequence of its analogy with kyanaethin. M. Engler has tried in vain to obtain salts of kyaphenin; he states that, unlike Cloez, he did not find ammonia abundantly given off, if kyaphenin were boiled even in sealed tubes at 150° C. with an alcoholic solution of caustic potassa. On treating the kyaphenin in a sealed tube at 220° with excess of fuming hydriodic acid, benzoic acid was formed, besides some iodide of ammonium and a small quantity of an oil, probably hexyl-hydrogen.

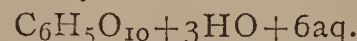
On the Existence of a Normal Propylic Alcohol.—By R. Fittig.—(*Ann. d. Chem. u. Pharm.*, vol. 159, No. 3, March, 1869.)—The discovery by Chancel of a normal propylic alcohol in fusel oil has been frequently disputed and contradicted. M. R. Fittig obtained from Dr. Marquard's well-known chemical works, near Bonn, a product which purported to be propylic alcohol, and which, notwithstanding its greater bulk, was made up of different alcohols, containing, on the whole, a very fair proportion of propylic. Instead of trying to separate these alcohols by a fractional distillation, which never yields satisfactory results, the author converted the whole of the raw material, by means of amorphous phosphorus and bromine, into bromides, and after purifying these, he separated them from each other by means of fractional distillation. He obtained a fluid boiling at 71° C., and on submitting it to elementary analysis, obtained from the fluid and its silver salt results which place the existence of Chancel's normal propyl alcohol out of all question. The raw liquid obtained from Dr. Marquard, above alluded to, was found to contain about 10 per cent of propylic alcohol.

Researches on Hungarian Wheat and Wheaten Flour.—By O. Dempwolf.—(*Ann. d. Chem. u. Pharm.*, vol. 159, No. 3, March, 1869.)—It is a well-known fact, that the composition of wheat varies according to climate and soil. At Pesth is established a most extensive dépôt and granary for the produce of Hungary, and also a very large establishment for grinding wheat. The analysis of the grain gave the following result for 100 parts:—Water, 10.511; ash, 1.505; gluten, 14.352; starch, 65.407; fatty matter and woody fibre, 8.225; together, 100.000. The existence of sugar could not be proved. The chief ingredients of the ash were found to be—phosphoric acid, 49.902 per cent; potassa, 31.825; magnesia, 14.862 per cent.

On Gummic Acid and some of its Combinations.—M. Felsko.—(*Ann. d. Chem. u. Pharm.*, vol. 159, No. 3, March, 1869.)—Gummic acid was first discovered by Reichardt, in 1863, and its name derived from the fact that this substance (the acid), accompanied by a gum-like matter, is formed when oxide of copper in alkaline solution is acting upon grape sugar. The anhydrous acid has the formula—

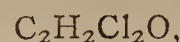


the hydrate is expressed by—



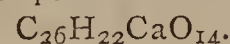
Neutral, or alkaline ammoniacal solutions of the acid are precipitated by chloride of calcium solution. Lime-water yields directly a precipitate. Chloride of iron does not precipitate the acid, or its salts, but does so on addition of alcohol; solutions of platinum and silver become reduced to metal when in contact with the acid. The acid combines with bases and oxides of metals to form salts.

On Bichloruretted Aldehyde.—M. Paterno.—(*Ann. d. Chem. u. Pharm.*, vol. 159, No. 3, March, 1869.)—The author has prepared this substance by distilling a mixture of bichloruretted acetal with from four to six parts, by bulk, of ordinary concentrated sulphuric acid. It is best to perform this operation in a retort, placed in an oil-bath and heated to about 130° C.; the receiver adapted to the retort is kept very cold, and the contents thereof are, after the end of the reaction, rectified. The fluid which comes over between 88° and 90° is the pure bichloruretted aldehyd; this liquid is heavier than water, and soluble therein, and likewise soluble in alcohol and ether; it boils between 88° and 90°, and its vapour strongly affects the eyes. Its elementary analysis yielded the following results:—Carbon, 21.23; hydrogen, 1.77; chlorine, 62.83; its formula is—



and the density of its vapour 3.9.

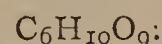
Phlobaphen.—(*Journ. f. Prak. Chem. v. Erdmann*, 1868, Nos. 23 and 24.)—Phlobaphen, an amorphous kind of tannic acid precipitable by acetate of lead, is, according to Grabowski, the principal constituent of the oak bark. When this phlobaphen is boiled with dilute sulphuric acid, it is split up into sugar and oak-red (eichenroth); this substance, purified as much as possible, and dried at 120° C., proved, on elementary analysis, to yield, in 100 parts—C, 55.4; H, 4.4. Combined with calcium, the composition of this substance is expressed by—



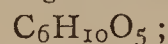
The oak phlobaphen is composed according to—



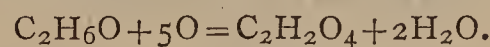
Isodulcite.—(*Journ. f. Prak. Chem. v. Erdmann*, 1868, Nos. 23 and 24.)—Isodulcite is a sugar-like substance derived from quereitrin, by boiling it with dilute sulphuric acid. M. G. Malin has studied the isodulcitic acid obtained from isodulcite by oxidising it with nitric acid; the acid so obtained crystallises, is almost insoluble in alcohol, readily soluble in water, and it does not exercise a reducing action upon an alkaline solution of copper. After having been dried over strong sulphuric acid, the elementary analysis of this substance leads to the formula—



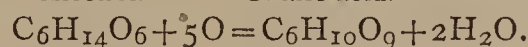
The isodulcitic acid is the most highly oxidised substance belonging to a series of compounds which begins with sugar of milk,



the acid alluded to originates from isodulcite, in the manner as oxalic acid is derived from alcohol—

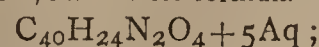


Alcohol. Oxalic acid.



Isodulcite. Isodulcitic acid.

Conchinine.—(*Journ. f. Prak. Chem. v. Erdmann*, 1868, Nos. 23 and 24.)—The alkaloid belonging to and derived from the Cinchona-trees, known as chinidine, β chinidine, β chinine, B chinine, cinchotine, crystallised chinoidine, and pitoyine, has been christened by Hesse conchinine, because it resembles chinine, as well as cinchonin. In order to prepare this conchinine, which occurs to upwards of 1.6 per cent in pitoya bark, the commercial chinoidine is the best source, since therein the conchinine is largely found. The chinoidine is repeatedly treated with eight times its weight of ether, this solution is filtered, and the ether removed by distillation; the residue is dissolved in dilute sulphuric acid, and afterwards carefully neutralised with ammonia. The solution is next treated with Seignette salt, whereby the tartrates of quinine and cinchonidine are precipitated, while the tartrates of cinchonine and conchinine remain in solution. After having treated the previously-filtered solution with animal charcoal, iodide of potassium is added to the warm solution, whereby hydriodide of conchinin is precipitated as crystalline powder; this salt is decomposed by ammonia, re-dissolved in acetic acid, re-purified with animal charcoal, and, lastly, treated with hot alcohol, from which it separates in crystalline form. The conchinine so obtained is soluble in 2,000 parts of water at 15°, in from 35 to 22 parts of ether, according to temperature, and in 26 parts of 80 per cent alcohol; the substance melts at 168° C., without charring. This substance, which is capable of forming several hydrates, has for its formula—



it forms, with acids, salts.

Analysis of Ripe Grapes.—(*Journ. f. Prak. Chem. v. Erdmann*, No. 1, 1869.)—Dr. Classen has done good service to science, as well as technology, by supplying us with these analyses; the grapes, three different kinds, grown in the neighbourhood of Kreuznach, were bought promiscuously in the market-place there:—1,000 grammes of fruit yielded—(1) 577, (2) 951, (3) 1032 grammes, juice; this consisted in 10,000 parts of solid substance dried at 100° C.—(1) 1644, (2) 1897, (3) 2046; grape sugar—1499, 1624, 1740; free acid—72, 68, 48; ash—27.83, 30.95, 40.08. The ash contains, as might be expected, a large proportion of potassa and phosphoric acid as the chief constituents, and beside chlorine, sulphuric acid, lime, silica, and small quantities of magnesia, and oxides of iron and manganese.

Notes on the Manufacture of Soap.—(*Journ. f. Prak. Chem. v. Erdmann*, No. 1, 1869.)—It is a well-known fact that, by an indirect process, a potassa soap may be converted into a soda soap; this is done by adding to a boiling solution of potassa soap a very concentrated solution of common salt; and it is generally taken for granted that, if enough of the latter has been added, the potassa is converted at least chiefly into soda, while chloride of potassium is formed. Neither in chemical nor in technological works the question *how much* of the potassa is substituted by soda has been answered; hence it occurred to Dr. Oudemans to ascertain this point, he having a good opportunity to do this by being acquainted with the proprietors of large soap-works. Without entering into the full details of his published paper on the subject, we quote the results obtained by him, which are these:—By the process as executed on the large scale, and yielding excellent produce, only a little more than half, to wit 53.7 per cent, of potassa is replaced by soda, while 46.3 per cent of potassa are left along with the other alkali combined with fatty acids in the curd soap.

NOTES ON LECTURE EXPERIMENTS.

Sudden Crystallisation.—I am afraid I can be of no further assistance to your correspondent "Crystal," as I have never met with the difficulty he describes. The bottle to be filled with the sulphate is thoroughly warmed, and the hot solution filtered into it. The same quantity has been used by me several times, the solidified salt being re-dissolved by placing the bottle in warm water, which is then heated to boiling.—ALFRED H. ALLEN.

Decomposition Cell.—Mr. Woodward's description of a glass cell reminds me of an arrangement I am in the habit of using, and a description of which may be of interest. The cell is made by cementing two pieces of window-glass on to a properly shaped piece of wood, by means of hot pitch. Platinum wires and plates present no difficulty; no clamps are required, and acids have little or no action on the pitch. A few weeks ago, I constructed a cell, by placing a piece of sheet gutta-percha between two glass plates heated before the fire. It lasted a few days, but then leaked; I think I can yet succeed in making it permanent. When the cell is to be exposed to great heat, as from the electric or lime light, the portion of the glass not required for transmitting light, should be covered with tin-foil which of course reflects the heat, instead of absorbing it like the pitch and gutta-percha.—ALFRED H. ALLEN.

NOTES AND QUERIES.

Wood Pulp.—Will any of your obliging contributors kindly inform me how to operate on wood shavings to convert them into white pulp? I have found them difficult to bleach even while employing much of the chloride of lime; the alkali I use is caustic soda, and the acid sulphuric. My results are not at all good; all I can obtain is a yellow pulp.—PAPER.

Electricity and Phosphuretted Hydrogen.—In making phosphuretted hydrogen the following formula is used:—

$$3\text{KHO} + \text{P}_4 + 3\text{H}_2\text{O} = 3\text{KPH}_2\text{O}_2 + \text{PH}_3.$$

To the above, in a test tube, I added a small quantity of iodine, and heated gently. In addition to PH_3 , I observed for the first time that electricity was given off. Will any of your correspondents kindly explain if there be a connection between the above method of production of electricity and the common method with zinc and sulphuric acid, &c.?—LEX, Liverpool.

[Will our correspondent inform us how the electricity was detected?—Ed. C. N.]

Melting and Solidifying Points of Fatty Matters.—M. Wimmel has proved, by a series of experiments, that the generally accepted rule, that the degree of temperature of solidification, and melting of solid fusible substances is exactly the same, does not hold good for fatty substances. Those properly so called—that is to say, those which yield glycerine on decomposition—become solid at a temperature far less high than that at which they become fluid; substances like beeswax and spermaceti become solid immediately their temperature falls below their melting point. M. Wimmel has found that when the solidification is retarded, there is always an increase of temperature when the solidification takes place. The fatty substance known as butter of mace becomes suddenly solid at 33° C., and this solidification is accompanied by a sudden increase of temperature to 42.2°, while the melting point of this fat is 45.5°. Some fats, like beef and mutton suet, do not become clear and quite transparent unless heated far above their melting point, while beeswax and spermaceti become transparent and clear long before they are entirely molten.

Mutual Decomposition.—**Analysis of Sewage.**—Perhaps you will be good enough to inform a new subscriber under what conditions of temperature and others, sulphate of lime and carbonate of magnesia mutually decompose each other, and form carbonate of lime and sulphate of magnesia; the approximate temperature at which the decomposition takes place; if the transposition of the acids is complete or partial; and, particularly, if the presence of silicate of alumina in large quantity, and of peroxide of iron in small quantity, may be expected to accelerate or retard the effect? And also if you will please point out any treatise showing the best mode of analyses of sewage and of water, particularly the quantitative determination of ammonia of nitrates, nitrites, and of phosphates.—W.

Preparation of Olefiant Gas, and the so-called Dutch Liquid.—Many years ago Mitscherlich discovered a process for the preparation of olefiant gas, which yields it almost continuously, and gives, at the same time, a very pure product. This process is based upon the fact that a sulphuric acid of such strength as to have its boiling point at 165° C. (a mixture of 10 parts by volume of strong sulphuric acid and 3 of water), decomposes the vapour of strong alcohol into water and olefiant gas. The full description of this process and also the simultaneous preparation of clay-chloride, or Dutch liquid, cannot be well understood without a woodcut; we therefore refer our correspondent to the very elaborate and full description to be found in vol. iv., pp. 545 to 558, of the *Handwörterbuch der Reinen und Angewandten Chemie von Liebig, Wöhler, und Poggendorff*, Brunswick, 1849, which work may be inspected at the Library of the Commissioners of Patents.

MEETINGS FOR THE WEEK.

MONDAY, 26th.—Medical, 8.

TUESDAY, 27th.—Royal Institution, 3. Professor Grant, "On Stellar Astronomy."

WEDNESDAY, 28th.—Society of Arts, 8.

— London Institution, 12. Anniversary.
 — Geological, 8.

THURSDAY, 29th.—Royal Institution, 3. Professor Tyndall, "On Light."

— Royal, 8.30.
 — Chemical, 8.

FRIDAY, 30th.—Royal Institution, 8. R. H. Scott, Esq., "On the Work of the Meteorological Office, Past and Present."

SATURDAY, May 1st.—Royal Institution, 2. Annual Meeting.

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THE CHEMICAL NEWS.

VOL. XIX. No. 491.

FURTHER RESEARCHES ON JARGONIUM, AND THE CEYLON JARGON.

By H. C. SORBY, F.R.S., &c.

IN my last note I told you that I had found in zircons what appeared to be another elementary substance. I have, since then, made many experiments, and find that the facts are really far more interesting than if they were the effect of a new element. Judging from analogy with all other known substances, no other conclusion could have been formed; but I now find that jargonia exists in two distinct conditions, which have different specific gravities and optical properties. The flamed borax beads give two entirely different spectra, according to the temperature to which the enclosed crystals have been exposed; and there is an analogous difference in the silicates. On taking a pale green jargon, which, naturally, showed a mere faint trace of the absorption bands, and keeping it at a bright red heat for some time, the specific gravity gradually increased from 4.20 to 4.52, and the spectrum then showed all the narrow black absorption bands in as great perfection as my best specimen. This fact is, of course, very interesting; since we can now artificially alter jargons so as to show the bands in the same splendid manner as a few do naturally, and shall thus be able to obtain them without much difficulty, to use as a most excellent natural standard scale, to measure the position of the absorption bands in other spectra.

Broomfield, Sheffield, April 24th, 1869.

ON A NEW ARRANGEMENT OF BINOCULAR SPECTRUM MICROSCOPE.*

By WILLIAM CROOKES, F.R.S., &c.

THIS instrument has been devised to obviate the disadvantages of the ordinary spectrum microscope. The principal features of the new apparatus are the sub-stage and the box of prisms. The former carries a sliding plate to hold the slit and apertures, a spring stop and screws for adjusting them, and a reversed object glass. The slit and this object glass are about two inches apart, and if reflected light is passed along the axis of the instrument, the object glass forms a very small image of the slit in front of it. A milled head moves the whole sub-stage, and screws bring the image of the slit to any part of the field. Beneath the slit is an arrangement for holding an object of irregular surface or dense substance. The stage has a concentric movement, so as to permit the object to rotate and enable the image of the slit to pass through it in any direction.

The direct vision prisms consist of three flint and two crown, fitted in a box screwed into the end of the microscope. By means of a pin they are thrown in or out of action. The object glass screws on in front of the prism box.

By taking the illumination from the sky or a white cloud, Fraunhofer's lines are visible, and by direct sunlight they are seen in great perfection; the dispersion is sufficient to cause the spectrum to cover the whole field, and the achromatism of the lenses being nearly perfect, the lines from B to G are practically in the same focus.

A double image prism near the slit enables two spectra to be seen, oppositely polarised, and the variations in the

absorption lines are at once visible. A Nicol's prism as polariser, and another as analyser, can be connected, and these enable the brilliant colours shown by some crystalline bodies when seen by polarised light, to be examined.

If a substance is dark coloured, or the illumination not brilliant, the whole of the light should be passed up the tube to one eye; but when the light is good, the appearance of the spectrum, and the power of grasping faint lines, are greatly improved by dividing the light with a Wenham prism, and using both eyes; whilst the stereoscopic effect thereby communicated to some absorption and interference spectra, throws a new light on the phenomena.

By using a spirit lamp instead of the illuminating lamp, the instrument answers admirably for examining flame spectra. The characteristic yellow, crimson, or green lines are seen beautifully sharp, on introducing sodium, lithium, or thallium into the flame.

ON SOME OPTICAL PHENOMENA OF OPALS.*

By WILLIAM CROOKES, F.R.S., &c.

By means of the above-described spectrum microscope some curious optical phenomena of opals have been observed.

If an opal which emits a fine broad crimson light is held in front of the slit of a spectroscop, or spectrum microscope, at the proper angle, the light is generally seen to be purely homogeneous, and all that is visible is a brilliant luminous line, varying somewhat in width, and more or less irregular in outline, but very sharp, and shining brightly on a perfectly black ground. If the source of light is now moved so as to shine into the spectrum apparatus through the opal, the above appearance is reversed, and we have a luminous spectrum with a jet-black absorption band in the red, identical in position, form of outline, and sharpness, with the luminous line previously observed.

From these and other experiments it has been found that those parts of the opal which emit red, yellow, green, or blue light are opaque to light of the same refrangibility which they emit. This is, doubtless, a general law, following, of necessity, the mode of production of the flashes of colour.

From the descriptions of the absorption phenomena of a series of opals, the following are selected as the most striking:—

No. 1 shows a single black band in the red. When properly in focus this has a spiral structure. Examined with both eyes it appears in decided relief, and the arrangement of light and shade are such as to produce a resemblance to a twisted column.

No. 2 gives an irregular line in the orange. Viewed binocularly, this exhibits the spiral structure in a marked manner, the different depths and distances standing well out; upon turning the milled head of the stage adjustment, so as to carry the opal slowly from left to right, the line is seen to revolve and roll over, altering its shape and its position in the spectrum. It is not easy to retain the conviction that one is looking merely at an absorption band in the spectrum, and not at a solid body possessing dimensions, and in actual motion.

No. 9 shows a very sharp and black band, stretching diagonally across the green, touching the blue at the top, and the yellow at the bottom.

No. 12 gives a narrow, straight, and sharply cut line in the green; this might easily be mistaken for an absorption band caused by an unknown chemical element.

Other opals show an absorption band travelling along the spectrum, almost from one end to the other, as the opal is moved sideways. All these black bands can be reversed, and changed into luminous bands, by examining the opal with reflected light.

* Abstract of a paper sent to the Royal Society, April 23rd, 1869.

* Abstract of a paper sent to the Royal Society, April 23rd, 1869.

CONTRIBUTIONS TO ANALYTICAL
CHEMISTRY.*

By Dr. E. FLEISCHER, of Dresden.

ON THE SEPARATION AND ESTIMATION OF COPPER IN
THE PRESENCE OF OTHER METALLIC SALTS.

In order to ascertain the amount of copper in a liquid which also contains other metallic salts, it will be found advisable to separate the copper from the solution in such a form as will be best adapted to its further estimation.

In analytical estimations of copper by weight, use may frequently be made, in the presence of sulphides easily soluble in weak muriatic acid, of the property possessed by chloride of copper of being precipitated in a warm acid solution by hyposulphite of soda. A drawback of this method is, however, that it does not allow any direct weighing of the dried precipitate, on account of the sulphur which is separated at the same time with the copper sulphide. Some chemists have recommended iodide of potassium, others, especially Rivot, sulphocyanide of potassium, for the separation of copper in acid solutions; neither of these are, however, to be especially recommended for analytical estimation by weight, because they do not allow of precision being attained by direct weighing. On the contrary, both these haloid salts of copper are highly suitable for its separation from other metallic salts and for the analytical determination of copper by measure, because almost all iodides and sulphocyanides collectively are easily soluble in muriatic acid, while, on the other hand, iodide or sulphocyanide of copper is insoluble, so that it is not possible to discover in the filtrate, after precipitation, any trace of copper by the aid of ferrocyanide of potassium. Of course much depends, especially for the complete precipitation of the iodide of copper, upon the means of reduction employed. Salts of sulphurous acid and even protochloride of iron are inappropriate, because iodide of copper is soluble in an excess of sulphurous acid, and still more easily so in sesquichloride of iron; but if a reducing agent be employed in precipitating the iodide of copper, capable, before the addition of iodide of potassium, of reducing cupric salts to subsalts, the precipitation of the iodide will be thoroughly complete. The most convenient reducing agent of this kind, and that best adapted for the purpose, is chloride of tin. If a solution of chloride of copper or blue vitriol be mixed with an excess of chloride of tin, the copper will be transformed into subchloride or subsulphate. On the addition of iodide of potassium, the copper will be so completely precipitated that no trace will be discoverable in the filtrate. As this iodide of copper is, then, one of the most suitable forms in which to analytically estimate copper by measure, I will proceed to describe the method more closely. With the aid of sulphate of peroxide of iron, which it transforms into a salt of protoxide, according to the formula—

$\text{Cu}_2\text{I} + 2(\text{Fe}_2\text{O}_3, 3\text{SO}_3) = 2\text{CuOSO}_3 + 4\text{FeOSO}_3 + \text{I}$, after separating the simultaneously-deposited iodine, the amount of copper may be easily calculated from that of the protoxide of iron formed, which is found by permanganate of potash. In order to obtain the copper as a chloride in a state of solution, it is necessary either to dissolve the oxide in muriatic acid, or to transform the sulphate into chloride by the addition of chloride of potassium or chloride of sodium. The presence of sulphate of potash will be found in no way detrimental. Nitrates may be treated in the same way, or, if too much free acid be present, it may be decomposed by digesting with excess of protochloride of iron. After the chloride of iron has been formed by one of these two methods, there must be added a proportionately large quantity of sal-ammoniac, say about 100 c.c. fluid, 8—10 grammes solid, salt. With this must be mixed distilled chloride of tin, or the yet stronger solution of chloride of tin and sal-

ammoniac, in such a proportion as to transform the whole of the copper into subchloride; if iron be also held in solution it will naturally be reduced to protoxide. It is obvious that a solution can contain no subchloride of copper in the presence of sesquichloride of iron, but that in the presence of chloride of copper it may contain protochloride of iron. If the reduction is sufficient, a paper dipped in strong iodide of potassium will not turn blue. Should it now be wished to precipitate the copper as iodide, an iodide of potassium solution must be added in sufficient quantity, and the cold fluid allowed to settle well*. In the presence of much sal-ammoniac this takes place very quickly, while, at the same time, the tendency of the finely-divided iodide to go through the pores of the filter is prevented. The iodide of copper, which is filtered off, must now be washed with a solution of sal-ammoniac until a solution of nitrate of silver in caustic ammonia will no longer render turbid the liquid which runs through, and until the latter will not precipitate Prussian blue from a mixture of diluted sesquichloride of iron with two drops of prussiate of potash. The iodide of copper which was washed is now placed in a solution of nitric acid, chlorine, and free sulphate of peroxide of iron, which more than suffices to transform all the copper into sub-salt; the free iodine is then driven off by heat until iodide of potassium and starch paper is not turned blue by the fumes, and diluted with cold water. The amount of the original protoxide of iron is now estimated with manganate of potash, and then the amount of copper is calculated according to the above-mentioned formula. It will be perceived that it is possible to estimate the liberated iodine by employing closed vessels, from which it is distilled into a solution of iodide of potassium, nevertheless I consider this process as superfluous, since the estimation of iron belongs properly to the most exact analytical methods.

Inasmuch as iodide of copper is an appropriate compound for the estimation of copper, so it is also especially adapted to discover and separate combined iodine in the presence of chlorine and bromine; and it fully replaces the expensive employment of palladium, provided the stated precautions are adhered to, and so much the more as it permits a direct estimation of iodine. An equally convenient method of estimating and separating copper is presented by precipitation by sulphocyanide of potassium. In the absence of sesquioxide of iron, copper can be as easily separated from its solution by sulphocyanide of potassium, when sulphite of soda is used as a reducing agent, as when chloride of tin is employed. The addition of sal-ammoniac is not indispensable, but it effects a better filtration and prevents the separation of oxide of tin.

The sulphocyanide of copper which is deposited from the muriatic acid solution is washed until the washings are not rendered turbid by alkali; the deposit is then digested for some minutes with a solution of caustic soda or potash; the red suboxide of copper now formed is allowed to settle a little and quickly filtered off. It is then washed with hot water until it no longer communicates a red tinge to acidulated sesquichloride of iron; the suboxide is then dissolved in a solution of sulphate of peroxide of iron, and estimated according to the known process. The estimation of copper as a sulphocyanide will be perceived to be rather more detailed than that of the iodide; however, by this method one may avoid the removal of the iodine by large quantities of water, which always takes up time. Moreover, as I have myself proved, sulphocyanide of copper serves as a means of estimation for hydrosulphocyanic acid even in the presence of cyanogen. I have observed in such cases that the transformation of the cyanogen into ferrocyanide of potassium (which is effected by digesting the alkaline solution with oxidised green vitriol) and the subsequent separation of the ferrocyanide of potassium from the acidulated solution, produce a very useful separation of

* Communicated by the Author.

* Here the syphon filter will be found very convenient if the precipitate be not too insignificant.

the cyanogen from the sulphocyanogen, especially if a little chloride of tin be previously added, so that all the iron may be held in the state of protoxide. It has already been remarked that copper can be separated in the presence of salts of other metals by either iodide or sulphocyanide of potassium. Lead, silver, and mercury alone are troublesome; however, silver may be separated by muriatic acid, and lead is precipitated with sufficient completeness by the addition of sulphuric acid. By means of chloride of tin, mercury is also deposited as Hg_2Cl , provided the solution be cold, so that the separation of copper from these three metals is tolerably simple. In the case of native sulphides I prefer, instead of the tedious and troublesome decomposition by *aqua regia*, fusing them with four parts of dry soda, three parts chlorate of potash, and two of common salt; this will effect, in a few minutes, a quiet and decided oxidation of the pyrites. The fused mass is directly dissolved in muriatic acid, and the copper separated from the filtered solution in the form of iodide or sulphocyanide, according to the method above-described.

ON THE
ESTIMATION OF COPPER IN ORES,
BY CERTAIN METHODS FOR WHICH A PREMIUM HAS BEEN
AWARDED.*

(Continued from p. 186.)

Dr. Steinbeck's method, which entirely answers to the conditions published by the directors of the mines, embraces three distinct operations, viz.:—1. The extraction of the copper from the ore; 2. The separation; 3. The quantitative estimation of that metal.

I. *The Extraction of the Copper from the Ore.*

A proof centner, equal to 5 grammes of pulverised ore, is put into a flask, and there is poured over it a quantity of from 40 to 50 c.c. of crude hydrochloric acid, of a specific gravity of 1.16, whereby all carbonates are converted into chlorides, while carbonic acid is expelled. After awhile, there is added to the fluid in the flask 6 c.c. of a normal nitric acid, prepared by mixing equal bulks of water and pure nitric acid of 1.2 sp. gr. As regards certain ores, however, specially met with in the district of Mansfeld, some, having a very high percentage of sulphur and bitumen, have to be roasted previous to being subjected to this process; and others, again, require only 1 c.c. of nitric acid instead of 6. The flask containing the assay is digested on a well-arranged sand-bath for half an hour, and the contents only boiled for about fifteen minutes, after which the whole of the copper occurring in the ore, and all other metals are in solution as chlorides. The blackish residue, consisting of sand and schist, has been proved by numerous experiments to be either entirely free from copper, or at the most only 0.01 to 0.03 per cent has been left undissolved.

The extraction of the copper from the ore, according to this method, is complete even in the case of the best quality of ore, which contains about 14 per cent of metal; while, at the same time, the very essential condition for the proper and complete separation of the metal, viz., the entire absence of nitric acid, or any of the lower degrees of oxidation of nitrogen, is fully complied with.

II. *Separation of the Copper.*

The solution of metallic and earthy chlorides, and some free hydrochloric acid, obtained as just described, is separated by filtration from the insoluble residue, and the fluid run into a covered beaker glass of about 400 c.c.

capacity: in this beaker has been previously placed a rod of metallic zinc, weighing about 50 grammes, and fastened to a piece of stout platinum foil. The zinc to be used for this purpose should be as much as possible free from lead, and at any rate not contain more than from 0.1 to 0.3 per cent of the latter metal. The precipitation of the copper in the metallic state sets in already during the filtration of the warm and concentrated fluid, and is, owing especially also to the complete absence of nitric acid, completely finished in from half to three-quarters of an hour after the beginning of the filtration. If the fluid be tested with sulphuretted hydrogen, no trace even of copper will be detected; the spongy metal partly covers the platinum foil, partly floats about in the liquid, and, in case either the ore itself or the zinc applied in the experiment contained lead, small quantities of that metal will accompany the precipitated copper. After the excess of zinc (for an excess must be always employed) has been removed, the spongy metal is repeatedly and carefully washed by decantation with fresh water, which need not be distilled, and care taken to collect together every particle of the spongy mass.

III. *Quantitative Estimation of the Precipitated Copper.*

To the spongy metallic mass in the beaker-glass, wherein the platinum foil is left, since some of the metal adheres to it, 8 c.c. of the normal nitric acid are added, and the copper thus dissolved by the aid also of moderate heat, in the form of nitrate of copper, which, in the event of any small quantity of lead being present, will of course be contaminated with nitrate of lead.

When copper ores are dealt with, which contain above 6 per cent of copper, which may be somewhat judged from the rather larger bulk of the spongy mass of precipitated metal, 16 c.c. of nitric acid, instead of 8, are applied for dissolving the spongy metallic mass. The solution thus obtained is left to cool, and next mixed, immediately before titration with cyanide of potassium, with 10 c.c. of normal solution of liquid ammonia, prepared by diluting 1 volume of liquid ammonia, sp. gr. 0.93, with 2 volumes of distilled water.

In the case of such ores as yield over 6 per cent of copper, and when a double quantity of normal nitric acid has consequently been used, the solution of copper in nitric acid is diluted with water, and made to occupy a bulk of 100 c.c.; this bulk is then exactly divided into two portions of 50 c.c. each, and each of these separately mixed with 10 c.c. of the liquid ammonia solution just alluded to, and the copper therein volumetrically determined. The deep blue-coloured solution of oxide of copper in ammonia only contains besides nitrate of ammonia, any lead which might have been dissolved having been precipitated as hydrated oxide of lead, which does not interfere with the titration with cyanide of potassium. The solution of the last-named salt is so arranged, that 1 c.c. thereof exactly indicates 0.005 gm. of copper. Since, for every assay, 5 grms. of ore have been taken, 1 c.c. of the titration fluid is, according to the following proportion:—

$$5 : 0.005 :: 100 : x = 0.1,$$

equal to 0.1 per cent of copper; it hence follows that, by multiplying the number of the c.c. of cyanide of potassium solution used to make the blue colour of the copper solution disappear, by 0.1, immediately indicates the percentage of copper contained in the ore.

As may be imagined, at the laboratory of the mine-owners at Eisleben, such a large number of assays are daily executed that, in this case, there can be no reason to fear a deterioration of the cyanide solution, of which large quantities are used and often fresh made; but for security's sake, the solutions are purposely tested for control at least once every week. According to the described plan, six assays can be made within 4 hours; and during a working day of from 7½ to 8 hours, twenty assays have been often made quite satisfactorily by the umpires, as well as the workmen at Eisleben.

* Translated from the original German from the *Zeitschrift für Analytische Chemie Von Fresenius*, 1869, No. 1.

Some Special Observations on the Volumetrical Estimation of Copper by Means of Cyanide of Potassium, bearing upon the Method just described.

Dr. Steinbeck considered it necessary to test his method specially, in order to see what influence is exercised thereupon by (1) nitrate of ammonia, (2) caustic ammonia, (3) presence of oxide of lead. The copper used to perform the experiments for this purpose was pure metal, obtained by galvanoplastic action, and was ignited to destroy any organic matter which might accidentally adhere to it, and, next, cleaned by placing it in dilute nitric acid. Five grammes of this metal were placed in a litre flask, and dissolved in 266.6 c.c. of normal nitric acid, the flask and contents gently heated, and, after cooling, the contents diluted with water, and thus brought to a bulk of 1000 c.c. exactly. Thirty c.c. of this solution were always applied to test and titrate one and the same solution of cyanide of potassium under all circumstances. When 5 grammes of ore, containing on an average 3 per cent of copper, are taken for assay, that quantity of copper is exactly equal to 0.150 gramme of the chemically pure copper. The quantity of normal nitric acid taken to dissolve 5 grammes of pure copper (266.6 c.c.), was purposely so taken, as to correspond with the quantity of 8 c.c. of normal nitric acid which is applied in the assay of the copper obtained from the ore, and this quantity of acid is exactly met with in 30 c.c. of the solution of pure copper.

As regards No. 1 and No. 2 (see above), the influence of double quantities of nitrate of ammonia and free caustic ammonia (the quantity of copper remaining the same), and the action of dilute solution of cyanide of potassium thereupon, will become elucidated by the following facts:—

(a). Thirty c.c. of the normal solution of copper, containing exactly 0.150 gramme of copper, were rendered alkaline with 10 c.c. of normal ammonia, and are found to require, for entire decolouration, 29.8 c.c. of cyanide of potassium solution; a second experiment, again with 30 c.c. of normal copper solution, and otherwise under identically the same conditions, required 29.9 c.c. of cyanide solution. The average of the two experiments is 29.85 c.c.

(b). When to 30 c.c. of the normal copper solution first 8 c.c. of normal nitric acid are added, and then 20 c.c. of normal ammonia solution, instead of only 8, whereby the quantity of free ammonia and of nitrate of ammonia is made double what it was in the case of the experiments spoken of under *a*, there is required of the very same cyanide solution 30.3 c.c. to produce decolouration. A repetition of the experiment, exactly under the same conditions, gave 30.4 c.c. of the cyanide solution employed; the average of both experiments is, therefore, 30.35 c.c.

The difference between 30.35 and 29.85 is equal to 0.5 c.c., and that figure is therefore the coefficient of the influence of double quantities; and supposing this to happen with the ores in question, it would only be equivalent to 0.05 per cent of metallic copper. It is hence clear that slight aberrations of from 0.1 to 0.5 c.c. in the measuring out of 8 c.c. of normal nitric acid, used to dissolve the spongy copper, and of 10 c.c. of normal ammonia, in order to render that nitric acid copper solution alkaline, is of no consequence whatever for the technical results to be deducted from the assay; it should be, moreover, borne in mind that the quantities of free ammonia and of nitrate of ammonia in the actual assay of ores, for which always a quantity of 5 grammes of ore is taken, varies according to the richness or poverty of the ores in copper; and the quotation of the following results of experiments prove that the influence of these substances is only very slightly felt affecting the accuracy of the results:—

Eight c.c. of the normal nitric acid have been found to contain, by means of a series of experiments, 1.353 grammes of anhydrous nitric acid; and this quantity of acid is exactly neutralised by 7.7 c.c. of normal ammonia

solution, which contains 0.6515 gramme of oxide of ammonium; and 10 c.c. of the said normal solution contain 0.846 gramme of oxide of ammonium.

One gramme of metallic copper requires, for complete oxidation, 0.2523 gramme of oxygen, and this quantity of oxygen is given off by 0.5676 gramme of anhydrous nitric acid; while, at the same time, bin oxide of nitrogen is disengaged. From these data can be calculated (1) the quantity of nitric acid which becomes decomposed when variable quantities of metallic copper are dissolved therein, (2) what quantity of nitric acid is left to form neutral nitrate of ammonia, and (3) what quantity of free ammonia will be left after a portion of that alkali has been combined with, and therefore neutralised by, oxide of copper, and any remaining free nitric acid. The following figures exhibit these variations:—

From Ores.	From 1.353 grms. of anhydrous nitric acid, equal to 8 c.c. of normal nitric acid,		From 0.846 grm. of NH_4O , as met with in 10 c.c. of normal solution of NH_3 , remain capable of forming ammoniacal oxide of copper,	
	When 5 grms. were taken for assay, were obtained of copper.	Become decomposed by the dissolution of the copper.	Remain, so as to be capable of forming nitrate of ammonia.	
Containing copper.	Per cent.	Grms.	Grms.	Grms.
1	0.050	.. 0.028	1.325	.. 0.208
2	0.100	.. 0.056	1.296	.. 0.222
3	0.150	.. 0.085	1.268	.. 0.235
4	0.200	.. 0.113	1.240	.. 0.249
5	0.250	.. 0.142	1.211	.. 0.263
6	0.300	.. 0.170	1.183	.. 0.276

It will be readily seen that the quantitative aberrations between ores containing 1 per cent or 6 per cent of metal, vary very little from the normal quantities exhibited by ores containing 3 per cent of metal. The relation is as 1 : 2; and, for technical purposes, this has been proved not to be a disturbing quantity.

When, however, larger quantities of ammoniacal salts are present in the fluid to be assayed for copper, by means of a titrated solution of cyanide of potassium, and especially when carbonate, sulphate, and, worse still, hydrochlorate, of ammonia are simultaneously present, these salts exert a very disturbing influence, as fully discussed in Fresenius's "Handbook of Analytical Chemistry," to which the reader is therefore referred. The presence of oxide of lead in the copper solution to be assayed has the effect of producing, on the addition of ammonia, 10 c.c. of normal ammonia, a milkiness along with the blue tint; but the presence of this oxide does not at all interfere with the estimation of the copper by means of the cyanide, provided the lead be not in great excess; and a slight milkiness of the solution even promotes the visibility of the approaching end of the operation.

Dr. Steinbeck has, however, purposely made some experiments to test this point, and his results are as follows:—He first prepared a solution of metallic lead in as little nitric acid as possible; and next diluted that solution, so that 1 c.c. thereof contained 0.0075 gramme of lead; with that solution the following experiments were made:—

(a). Thirty c.c. of normal copper solution, containing 0.150 gramme of copper, and 10 c.c. of normal ammonia solution, required, for complete decolouration, 29.9 c.c. of solution of cyanide of potassium.

(b). Thirty c.c. of the same solution as *a*, and in addition thereto 2 c.c. of solution of lead, containing 0.015 gramme of lead, equal to 10 per cent upon the quantity of copper, required of cyanide solution 30.0 c.c.

(c). Thirty c.c., as above under *a*, and addition thereto of 4 c.c. of solution of lead, containing 0.030 gramme of lead, equal to 20 per cent upon the quantity of copper, required of cyanide solution 29.9 c.c.

(d). Thirty c.c., again as above under *a*, and addition thereto of 10 c.c. of solution of lead, containing 0.075

gramme of lead, equal to 50 per cent upon the quantity of copper, required of cyanide solution 30.0 c.c.

(e). Thirty c.c. of copper solution again, and addition thereto of 20 c.c. of solution of lead, containing 0.15 gramme of lead, equal to 100 per cent upon the quantity of copper, required of cyanide solution 30.1 c.c.

Since neither 50 nor 100 per cent of addition of lead exerts any perceptible influence upon the estimation of copper from its ores, or otherwise, by means of cyanide of potassium, a small quantity of accidentally-occurring lead will not affect the results, and this the less so, as, generally, no ores of both metals occur together, wherein both are met in sufficient quantity to make it worth while working the ore for both metals at the same time.

Since it is well known that the presence of zinc very perceptibly influences the action of a solution of cyanide of potassium, when applied to the volumetrical estimation of copper, Dr. Steinbeck considered it necessary to institute some experiments, in order precisely to ascertain, with what quantity of zinc present along with copper, this influence commences to become perceptible. The solution of zinc applied was made by dissolving the metal in the smallest possible quantity of nitric acid; and 1 c.c. of that solution contained 0.001 gramme of zinc. The results of the experiments recorded in the following tabulated form were made with this solution of zinc:—

Copper Solution.		Normal Ammonia.		Zinc Solution.		Percentage upon Copper.		Solution of Cyanide required.	
c.c.	Copper in grms.	c.c.		c.c.	Zinc in grms.			c.c.	
30	0.150	..	10	..	—	..	—	..	30.00
30	0.150	..	10	..	1.5	0.0015	..	1	.. 30.00
30	0.150	..	10	..	3.0	0.0030	..	2	.. 30.10
30	0.150	..	10	..	4.5	0.0045	..	3	.. 30.00
30	0.150	..	10	..	6.0	0.0060	..	4	.. 30.00
30	0.150	..	10	..	7.5	0.0075	..	5	.. 30.05
30	0.150	..	10	..	10.5	0.0105	..	7	.. 30.60
30	0.150	..	10	..	10.5	0.0105	..	7	.. 30.60
30	0.150	..	10	..	15.0	0.0150	..	10	.. 30.90
30	0.150	..	10	..	22.5	0.0225	..	15	.. 31.20

The presence of zinc does not interfere with the visibility of the end of the reaction, viz., the decolouration of the copper solution. The results of the experiments herewith quoted prove that a small quantity of zinc, less than five per cent of the quantity of copper present, or 0.0075 gramme by weight of zinc, does not at all affect the action of the solution of cyanide of potassium; but when the quantity of zinc increases, a very perceptible effect is seen upon the solution of cyanide; it is therefore necessary to bestow due care while washing the spongy copper, after it has been precipitated by means of zinc from its solution (see above, under II.).

Since it has been ascertained that the action of solution of cyanide of potassium in researches of this kind is also affected by an increased temperature of the solution of copper which is to be titrated therewith, it is strictly necessary never to operate with warm solutions of ammoniacal copper, but to suffer the same to cool down to the ordinary temperature of the air of the laboratory.

While 30 c.c. of copper solution, containing 0.15 gramme of copper, and 10 c.c. of normal ammonia solution, required, at the ordinary temperature, 30.0 c.c. of cyanide solution; the same quantities required, at between 40° to 45° C., 28.8 c.c. of solution of cyanide; and at 45° C., 28.9 c.c. of the same solution, thus proving the injurious effect of warm solutions.

(To be continued.)

Test for the Genuineness of Chocolate.—M. Reinsch.—(*Pharm. Zeitschr. f. Russland*, No. 2, 1869.)—One part, by weight, of chocolate is ground to powder and mixed with ten times its weight of hot water, the mixture boiled for a minute, next cooled, and then poured on a paper filter. When the chocolate is genuine—that is to say, has not been adulterated with starch, wheaten flour, or starchy matter of any kind—the fluid is not thick, and easily runs through the paper; the filtrate is also clear, and exhibits a light brownish red fluid agreeable to the taste. The reverse is the case with adulterated chocolate.

NOTE ON

THE DISCOVERY OF THE WEIGHT OF THE AIR.

By G. F. RODWELL, F.C.S.

IN the last number of this journal, M. l' Abbé Hamy has replied at some length, and with much ingenuity, to certain statements, by which I endeavoured to prove that Aristotle did not discover the weight of air by direct weighing; and I am bound to confess that his further discussion of the subject has not caused me to alter my opinion, the grounds for retaining which will be best indicated by considering the nature of the objections. It is with regret that I differ from M. Hamy, for he has preserved throughout a courteous spirit too rarely to be met with in controversies, and I will here beg him to discover no discourtesy in the following remarks, which are not made in a contentious spirit, or in forgetfulness of his much learning.

M. Hamy commences his animadversions by giving the Greek, Latin, French, and English texts of the disputed passage, in order to show that the word usually rendered *bladder* should be in reality *leather bag* or *bottle*; this I am quite willing to cede: *ἀσκός* (perfectly rendered in the Latin translation by *utrem*, and in the French translation by *outre*) rightly signifies a wine-skin or leather bottle, literally *the skin of an animal*; such skins were not alone used for containing liquids, but were sometimes inflated with air and employed by swimmers and by fishermen; in the British Museum there is a representation, on one of the sculptured blocks of Ancient Assyria, of a fisherman supported in mid stream by an inflated skin. Seeing that the word is *ἀσκός*, it is strange that it should so invariably, both by ancient and modern commentators, be rendered *bladder*, and that Ptolemy the mathematician, and Simplicius, should have repeated the experiment with a bladder; it is to be borne in mind, however, that the latter would always be easier to procure and more convenient for the experiment than a wine-skin, both on account of its greater flaccidity, and because it could be more easily closed air-tight: Mr. G. H. Lewes, an exact and profound scholar, writes as follows, in a discussion of the treatise *Περὶ οὐρανοῦ*, in, I suppose, the most exhaustive modern work on the scientific knowledge of Aristotle*:—"In other words, everything except fire in its own place, has weight. That even air has weight is proved by the fact that a bladder filled with air is heavier than the same bladder empty."

The main point of M. Hamy's former communication was to show that Aristotle employed, "*not an extensible bladder, but an almost inextensible leathern jar successively full and empty of air.*" He now says—"Everybody admits that a leathern bottle, whether formed with a skin or consisting of a bladder, constitutes an open extensible vessel, capable, however, of being bent or flattened. Resistance to extension does not, in fact, imply absolute rigidity, and a body can cease to be extended without becoming stiff. It can also be said that a leathern bottle is very slightly extensible, without its meaning rigid. We comprehend, then, that a leathern bottle can receive compressed air." Now I say this is an argument in a circle, if ever there was one; it is a sophistry essentially *me liæval*; a modus of reasoning which reminds me somewhat of the argument of the brazen seal concerning matter and form, in the *Introductio ad Theologiam* of Peter Abelard; in character it appertains more to the theologian than to the man of science; it savours of the Sorbonne rather than of the Lycée Napoleon. "And though," says Master Peter, concerning the brazen seal, "they are essentially the same thing, yet the brazen seal is made of the brass, not the brass of the brazen seal, and the brass is the matter of the brazen seal, not the

* "Aristotle: a Chapter from the History of Science, including Analyses of Aristotle's Scientific Writings," chap 7, p. 142.

seal of the brass," and so on interminably with excessive ingenuity and subtlety. No wonder Abelard was the most brilliant disputant and dialectician of his age; who could answer such an argument off-hand in a public debate, and who could answer off-hand the argument given above about resistance to extension, and the marvellous corollary? This must surely be an example of one of the "useless and illegitimate" moods of the syllogism of which Aristotle writes. Again, if "almost inextensible," how can the leathern bottle be said to be "open and extensible?" The fact is M. Hamy has shifted his ground, and the former arguments rise up and destroy the latter, as the armed men which sprang from the teeth of the dragon slew each other when Jason threw a stone into their midst. I certainly cannot admit that πεφυσημενος ἀσκός means either "an almost inextensible leathern jar, or a leathern bottle which, without being rigid, "is very slightly extensible." Πεφυσημενος (φυσάω) clearly signifies *blown out*, or *inflated*, and there is no idea of partial inextensibility in the whole phrase, neither would Aristotle have spoken of a leather bottle full of air (that is already inflated), as κενός, and of the same bottle as πεφυσημενος when air was compressed into it. This is a mere perversion of terms. Whether the receptacle employed were a bladder or a leathern bottle, it was capable of existing in a state of collapse (κενός) and in a state of inflation (πεφυσημενος), and the basis of the experiment described was the causing the receptacle to pass from the former to the latter state, in all probability as Simplicius asserts, by forcing air into it from the lungs.

In M. Hamy's former communication (p. 119 of this volume) he says, "For myself, I believe that the great philosopher, by means of a blowpipe, confined in his leathern jar more air than it would contain at the normal pressure." He now entirely deserts this position, and calls up a *Deus ex machinâ* to account for the filling of the vessel. "Mr. Rodwell," he says, "reasons, in the persuasion which he seems to entertain, that Aristotle would have been obliged to swell the bladder with his own breath." I "reasoned in this persuasion" both because M. Hamy, whose argument I was answering, so reasoned, and further, because one of the most profound and exact of the older commentators of Aristotle likewise gives it as his persuasion. Then comes the *Deus ex machinâ*. "But this supposition is unfounded. Long before the philosopher's time, if Homer is to be believed, the Greek smiths were acquainted with the use of bellows." I may add that long before the time of Homer, the Egyptians were acquainted with bellows; and it is believed that they introduced a valve at least as early as the time of Moses*; and further, as I have elsewhere endeavoured to show,† that bellows were probably invented by the makers of these leathern bottles of which we are speaking. Then as to the question of the balance, if we admit, with M. Hamy, that the ancient Greeks possessed balances capable of weighing minute quantities of gold (of which I believe we have no proof), it would be impossible that a wine skin capable of holding fifteen litres (the size which he assumes), could be weighed by such a balance, neither could compressed air be retained in a vessel of this nature.

Next as to those who repeated the experiment and failed, M. Hamy says, "Ptolemy and Simplicius denied Aristotle's assertion because they did not admit the theoretical explanation of the philosopher;" on the contrary, they were well versed in the writings of Aristotle, and they repeated the experiment with every hope of success. The fact that Averroës (or Ibn-Roschd, as M. Renan‡ prefers to call him) "affirms that he succeeded,"

* "Manners and Customs of the Ancient Egyptians," by Sir G. Wilkinson.

† CHEMICAL NEWS for September, 1863.

‡ See his admirable "*Averroës et Averroïsme*;" also Figuier's "*Vies des Savants du Moyen Age*." There is a large collection of MSS. attributed to Ibn-Roschd in the library of El Escorial. Averroës is a Spanish form of the Arabic Ibn-Roschd; it was sometimes spelt Averrhoës or Adverroys; his full Arabic name was Aboulwalid - Mohammed - Ibn - Ahmed - Ibn - Mohammed - Ibn - Roschd. He was born in Cordova, in 1126; died 1198.

I think of but little value, and for the following reasons:—When the Sultan Yakoub-Jossouf requested Ibn-Roschd to compose a commentary on the works of Aristotle, he was probably unaware that he did not understand Greek; the fact being that Ibn-Roschd studied Aristotle through Arabic or Syriac translations, which, in their turn, were made from a Latin translation;* and yet this man was called "*L'ame d'Aristote*," and it was mainly through him, assisted by the University of Cordova, that the Peripatetic dogmas were disseminated, and that the stupendous mass of false philosophy and perverted Aristotelianism, called Scholasticism, arose to fetter the intellect of Europe. Surely Simplicius and Ptolemy ought to be heard before a man who received his knowledge of Aristotle not even at second-hand. At this time, Heloise was one of the very few Greek scholars in Europe. With all respect for the University of Cordova, then the most famous and learned university in Europe, I do not think that the critical knowledge of Greek possessed by it as a whole would have satisfied a Regius Professor of our day.

M. Hamy speaks of Aristotle as "the most exalted genius that human reason, left to its own powers, has produced." While admitting that he was one of the most exalted geniuses which the world has produced, I cannot say that his intellect was "left to its own powers." He was sufficiently wealthy to procure a good library at a time when books were extravagantly expensive, and to these he applied himself so well that he received the name of "the Reader." He was seven years at the court of Macedon, and Alexander the Great, first his pupil, remained his friend, and did all that was possible to further his literary labours; but, above all, for no less than seventeen years Aristotle enjoyed the instruction and the friendship of Plato, the greatest and divinest of Greeks, "the finest of human intellects, exercising boundless dominion over the finest of human languages." No; if ever there was a man who possessed every possible intellectual advantage which his age could furnish, that man was Aristotle.

Having now considered M. Hamy's arguments, little remains to be said. The sentence which has furnished us with this discussion is sufficiently brief:—*Ἐν τῇ αὐτοῦ γὰρ χώρα πάντα βάρος ἔχει πλὴν πυρός, καὶ ὁ ἀήρ. Σημεῖον δ' ὅτι ἔλκει πλείον ὁ πεφυσημένος ἀσκός τοῦ κενοῦ.* Looking at it either in its most literal or most paraphrastic form, analysing it, confronting it with collateral evidence, surrounding it with sophistries, applying to it the subtlest forms of argumentation, I yet see not that we can deduce from it the fact that Aristotle discovered the weight of air. Whether he used his own lungs or a pair of bellows to inflate his receptacle matters little; whether that receptacle were a bladder or a leather bottle matters less, but it must needs be shown that the receptacle could contain within it compressed air in sufficient quantity to show a difference of weight when it was weighed in air; that it could be closed securely while containing compressed air; and that no leakage could ensue; finally, that there were balances capable of weighing such bulky things, and at the same time of indicating the slight difference of weight possible under the circumstances. Till this can be demonstrated we must still admit that Galileo made the first accurate and conclusive experiments to demonstrate by direct weighing that the air has weight. It is surprising to find Aristotle designated a good experimentalist; he was indeed an ardent inquirer and a careful observer, but he seldom attempted to examine material facts by a suitable methodical instrument; he lacked even the rudiments of an experimental method; he was insufficiently critical in regard to physical matters. But he was so infinitely great in many respects that, if he had been a great experimentalist, the world would not have regarded him as a

* Mr. Lewes has stated the case forcibly in the following sentence:—"The barbarous jargon which the European Schools had to master, when they opened Latin versions of Averroës, may be imagined when it is known that these were Latin translations from a Hebrew version of an Arabic commentary on an Arabic translation of a Syriac version of a Greek text:" that is the original text of Aristotle.—*History of Philosophy*, vol. ii., p. 60.

greater man. Discoveries are rarely born out of due time; when the world is ready for them and the *modus* of its thought capable of assimilating them, then they appear; if they appear out of due course, and fall upon an uncongenial age they die out and are lost. Facts—whether they be social, political, metaphysical, or physical—belong to ages of development, characterised by the conditions of peoples, of civilisation, of mental calibre, and of intellectual activity; and the intellectual activity of an age breaking as a wave upon the shores of humanity, leaves a residue which gradually accumulates, and forms a resting place upon which more advanced phases of thought repose.

PROCEEDINGS OF SOCIETIES.

NEWCASTLE CHEMICAL SOCIETY.

THE concluding meeting of the Society was held on Thursday, the 22nd inst., the President, J. L. BELL, Esq., in the chair.

Dr. LUNGE read an "Abstract of the Contents of the *Annales des Mines*, for 1868."

Mr. BOWMAN read an "Abstract of M. Caron's Pamphlet, on *Magnesia as a Furnace Material*."

Mr. B. S. PROCTOR read a "Note on Medicinal Rhubarb."

FRENCH ACADEMY OF SCIENCES.

Monday, April 19th, 1869.

AMONG the large number of papers read—some of which do not interest us, being either purely mathematical, astronomical, or belonging to applied mechanics—we meet, in the first place, with a brief note from M. Delaporte concerning the communications made by MM. Cailletet and Berthelot, on the part pressure plays upon some chemical phenomena; since that note is, however, purely theoretical reasoning, not supported by any experiments, and while it, moreover, does not advance our real knowledge about this question at all, the President thought it ought not to be discussed.

M. J. E. PETREQUIN read a short paper "On the Cerumen contained in the Human Ear." This substance had been analysed by Vanquelin, and also many years ago by Berzelius; the recent researches of the author prove that it contains about one-tenth of its weight of water; a fatty substance made up of oleine and stearine; a potassa soap soluble in water and alcohol, insoluble in ether at the ordinary temperature of the air; also another potassa soap, insoluble in alcohol, but soluble in water; lastly, an organic substance insoluble in water, ether, and alcohol, containing, moreover, lime, potassa, and soda.

M. RABACHE proposed, instead of expressing the equivalents of the elements as multiples of the equivalent of hydrogen taken as unity, that the figure should be 0.25, as this would simplify the tables of equivalents.

M. DUMAS observes thereon that the equivalent of potassium is not the multiple of 0.25, or $\frac{1}{4}$, but of $\frac{1}{8}$, and moreover states that really there is no warrant for any such change at all.

M. SORET communicated that, after having read Professor Tyndall's note "On the Clouds," he had felt induced to examine, by means of the polariscope, the beautifully blue colour exhibited by many parts of the lake of Geneva, and he stated that this colour was due to the presence of solid particles in the water and of the same specific gravity as that fluid; but he does not say what these particles are nor what size or shape they have, promising, however, further researches.

M. DUBRUNFAUT stated as the conclusion he has been

brought to by a series of researches on supersaturation, solution, and superfusion, that the molecular constitution of dissolved substances is different from that which the same substance exhibits when crystallised.

M. DUMAS performed, at this meeting, the following experiment in order to illustrate the paper "On the Action of Heat upon the Peroxide Salts of Iron," by M. Debray:—In a large portion of distilled water some few drops of a neutral solution of chloride of iron are poured, care being taken not to apply so much of the salt that its colour is at all imparted to the water; on heating the liquid gradually up to, and above, 70° C., it becomes perceptibly brown-coloured. When that moment has arrived, the water no longer contains chloride of iron, but instead a mixture of free hydrochloric acid and free peroxide of iron; the limpidity of the fluid is not, however, at all impaired. In order to prove this, it is only requisite to pour into the fluid a solution of common salt, whereby the static equilibrium, of the liquid is disturbed and the oxide of iron precipitated. When the experiment is made in sealed tubes, and the latter heated to between 200° and 300° C., crystalline oxide of iron is precipitated.

MM. FRIEDEL and LADENBURG sent a paper on the preparation and properties of a compound which only differs from oxalic acid by the substitution of silicium for the carbon of the acid just named. We intend to return to this paper, and also to publish the interesting papers on the areometer of Baumé, by M. Baudin, and that on the essence of sassafras, by M. Grimaux.

M. MAUMENE communicated some further researches made by him "On the Action of Potassium upon Dutch Liquid," the result of which is that, when the metal is in excess, three gases are given off, but when the liquid is in excess, only one of these appears, while the two others remain in solution.

MM. CHAPELAS-COULVIER-GRAVIER, E. ROBERT, and TREMESCHINI described at this meeting the brilliant aurora borealis seen at Paris on the night of the 15th inst., from a quarter past nine until about eleven o'clock; the phenomenon was remarkably developed, completely occupying the N.E. to the W.N.W. portion of the sky. It appears that not only the very sensitive magnetic instruments at the observatory, but even those at the telegraph stations, were perceptibly disturbed.

CORRESPONDENCE.

EQUIVALENCE AND QUANTIVALENCE.

To the Editor of the Chemical News.

SIR,—In your report of the last meeting of the Chemical Society appear some valuable remarks of the President, Dr. Williamson, on the injurious confusion which is introduced into chemical science by the indeterminate significance, and interchangeable use, of the two words *atomicity* and *equivalence*. Dr. Williamson deprecated the shifting and uncertain sense which had been attached to these expressions by various speakers during the evening's debate. He also demurred to the introduction of such words as "bond" to express the function or property in virtue of which chemical compounds are held together. "He would not," he added (according to your report), "express any opinion as to whether the *atomicity* theory was right, or the *equivalence* theory, but they were different."

While humbly supporting with my entire concurrence the earlier part of the learned President's observations, I would venture, with deference, to submit that, into his las

above-quoted phrase, there seem to have crept some traces of that vagueness which he himself so earnestly deploras. Let me, however, hasten, in fairness, to say that the phrase, as reported, wears the aspect of an abridgment, in which the full sense of the speaker's words may have suffered by compression; so that it should be only after revision by Dr. Williamson himself that the report should be taken to convey his precise meaning.

With this reservation, I take the phrase as it stands in your columns, and ask permission, in the interests of neo-chemistry, respectfully to point out that, in referring to atomicity and equivalence as opposed theories, standing in such mutual antagonism as to comport the expression of an opinion "whether one or the other be right" the speaker seems to have been betrayed (doubtless by the haste of improvisation) into a temporary oblivion of well-known and momentous laws.

Those laws, and the most suitable forms for their expression, it devolved upon me to study with the utmost care, during my collaboration with Dr. Hofmann in his "Introduction to Modern Chemistry," and especially while writing the philosophical chapters of that work; a duty which, owing to the illustrious Professor's many and pressing engagements at the time, had, in a great measure, to be entrusted to my inferior hand.

If, therefore, it be opportune, during the prevalence of the unsettled opinions exemplified above, to submit for consideration statements of those laws, in terms at least free from vagueness, whether otherwise admissible or not, I hope that my intervention to fulfil this duty will not, under the circumstances mentioned above, be deemed unduly obtrusive.

Thus much explained, and audience taken as therefore granted me, I strike at once into the heart of the subject, by offering, in the concisest language at my command, exact definitions of *equivalence* and *atomicity*; or, as I prefer to term the latter, *quantivalence*.

To prepare the mind for grasping these definitions, I would first observe that the former expression, *equivalence*, is essentially *ponderal*, and is the answer (so to speak) made by each kind of matter to the question *How much?* while the latter expression, *quantivalence*, is essentially of *numerical* significance, and is the reply of each kind of matter to the experimentalist's question, *How many?*

This preliminary indication shows us, at once, that there is no such antagonism between these two aspects of chemical enquiry as Professor Williamson (if correctly reported) was led at the moment to suppose; that it is not necessary to enquire "whether one or the other theory be right," but that, on the contrary, both views may be true—nay, not only *may*, but *must* be true, seeing that they are but the separate expressions of co-existent and co-relative facts.

The *fact*, of which equivalence is the expression, is the reply which a material element makes, from the pan of the balance, to the question propounded in the retort or crucible—*How much of you, by weight, is the minimum quantity, relatively to an assumed standard-unit (H=1), requisite to take part in the formation of a compound molecule?*

To this clear question chlorine as clearly replies, 35.5; oxygen answers, 16; nitrogen, 14; carbon, 12; and so on throughout the elemental list.

The *fact* which *quantivalence* (somewhat barbarously called also *atomicity*) purports to express, is the reply made by an element, to the analytic and synthetic interrogation:—*How many standard atoms (H=1) is your minimum molecule-forming weight, or equivalent weight, above defined, capable of fixing, to form a compound molecule, or of replacing, in a compound molecule already formed?*

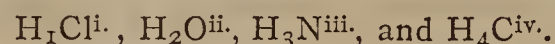
To this distinct question (How many?), chlorine distinctly answers 1; the reply of oxygen is 2; of nitrogen, 3; of carbon, 4; and these numbers, written small, each

against the name of the respective element (represented by its initial), denote the respective *co-efficients of quantivalence*. Instead of numerals, dashes, in appropriate number, are frequently used to signify these co-efficients, which conspicuously stamp on each element's symbol its relative atom-fixing and atom-replacing power, or (if I may so express the fact) its chemical *value in exchange*.

These quantivalential co-efficients find their most convenient *spoken* enunciation in the Latin numerical prefixes—*uni*, *bi*, *tri*, and the like. Thus: we call chlorine *univalent*, and write it Cl^{i} or Cl' ; oxygen, we term *bivalent*, and write it O^{ii} or O'' ; nitrogen we denominate *trivalent*, and write it N^{iii} or N''' ; while carbon is designated *quadrivalent*, and written C^{iv} or C'''' .

Turning to the phenomena themselves, which afford us this distinct information, we find in equal volumes of hydrochloric acid, water, ammonia, and marsh-gas (all, of course, taken in the vaporised or gaseous condition), the constituents Cl, O, N, and C, in the proportions due to their respective equivalent weights—35.5, 16, 14, and 12; while, upon counting the standard atoms ($\text{H}=1$) in each compound, we find 1 in the first-named (HCl), 2 in the second (H_2O), 3 in the third (H_3N), and 4 in the fourth (H_4C).

By writing into these formulæ the respective co-efficients of quantivalence of the elements engaged, the balance of the forces in play, or, as I have ventured to call it, their *quantivalential equilibrium*, is beautifully shown; thus we have—



It is remarkable that the numerical quantivalence of the elements varies quite irrespectively of their ponderal equivalence, or relative combining weights; the combining weights in the series above, for example, happening to diminish progressively, whilst the atom-fixing powers, on the contrary, increase, thus:—

Cl = 35.5	fixes one atom only of H.
O = 16	„ two atoms „
N = 14	„ three „ „
C = 12	„ four „ „

These higher and lower *numerical* relations, or attractions, of the elements, are, nevertheless, to be carefully distinguished from the gradations, more or less intense, of their *chemical* activity, or (if I may so say) from the *specific chemism* of each. For example, the one atom of hydrogen which *univalent* chlorine fixes, may (and does) happen to be held with much more force than that which carbon, albeit *quadrivalent*, puts forth in grasping its four-fold complement of atoms. And so, again, to illustrate the point in another way, though potassium and hydrogen are both but *univalent* bodies, yet the former (K) by reason of its superior *specific chemism* for oxygen, takes oxygen from the latter (H) with explosive rapidity and force.

It is not, however, my present business to dilate on the beauty or to develop the conditions of these marvellous endowments of material bodies, so much better known to those I address than to myself. The strict limits I have here to observe extend only to the clearing up of certain prevalent misconceptions as to the precise import of the terms *equivalence* and *quantivalence*; as also of the latter's derivatives—*univalent*, *bivalent*, *trivalent*, *quadrivalent*, *multivalent*, and the like; derivatives, let me add, *passsim*, of more classical construction than such hybrid terms as *monovalent*, *polyvalent*, &c., formed by the intermingling of Latin and Greek, and which I regret to see so often employed.

As for the alternative expression, *atomicity*, its meaning, as marked by its derivation, seems to be "indivisibility;" a meaning altogether inappropriate, otherwise than by a purely arbitrary convention, to express the idea of chemical value in exchange, which quantivalence, on the contrary, aptly denotes. Atomicity is, indeed, a weak neologism into which chemists seem to have drifted, for want of a better word, at the time when chemical philosophy was beginning to undergo its great modern trans-

formation. Let us hope that so defective a term may soon give place, by common consent, to the more significant and appropriate term *quantivalence*.

Let us, in conclusion, also hope that between these two terms, *equivalence* and *quantivalence*, as well as between the great laws they imply, all ambiguity and confusion may henceforth cease.—I am, &c.,

F. O. WARD.

London, April 25th, 1869.

MISCELLANEOUS.

The Royal Society.—The following is the list of the gentlemen who have been selected by the Council for election into the Royal Society this year:—Sir Samuel White Baker, M.A., eminently distinguished as a geographer and explorer of distant lands; John J. Bigsby, M.D., distinguished as a geologist and palæontologist; M. Charles Chambers, director of the Colaba Observatory, Bombay; Mr. William Esson, M.A., of Merton College, Oxford; Mr. George Carey Foster, B.A., Professor of Physics in, and Fellow of, University College, London; William W. Gull, M.D., London, distinguished as a physician and as a teacher of the medical sciences; Mr. J. Norman Lockyer, distinguished as an astronomer; Mr. John Robinson M'Clean, C.E., late President of the Institution of Civil Engineers; Mr. St. George Mivart, Lecturer on Comparative Anatomy at St. Mary's Hospital; John Russell Reynolds, M.D., Professor of Clinical Medicine in University College, London; Vice-Admiral Sir Robert S. Robinson, K.C.B., Controller of the Navy; Major James F. Tennant, R.E., late astronomer at Madras; Wyville Thomson, LL.D., Professor of Zoology, Botany, and Geology in Queen's College, Belfast; Colonel H. E. Landor Thuillier, R.A., eminent as an Indian geographer; and Mr. Edward Walker, M.A., distinguished for his mathematical and literary attainments.

"Previous Sewage Contamination."—A discussion is going on at the meetings of the Metropolitan Association of Medical Officers of Health on the subject of "Contamination of Potable Water by Sewage," and the following are questions, having especial reference to *rivers*, on which information is desired:—

Supposing town sewage, discharge of water-closets, &c., to be poured into a running stream, does it undergo oxidation, so that its noxious qualities are lost, and the water restored to a wholesome state? Can you give any instances showing what distance of run in a river will suffice to purify water contaminated with a certain bulk of sewage? Admitting that exposure to sun and air during a run of a certain number of miles in a river will suffice to oxidise dead and decomposing matter, yet there is the hypothesis that *living matter* (*germinal matter*, shapeless organic matter, or germs, cells, or spores of fungi, ova of parasites, &c.) proceeding from diseased bodies, may be conveyed by river water, and be the cause of disease. Have you any facts showing that disease of any sort has been propagated by such living matter, after a flow of a certain number of miles down a river? Of two towns on the same river—one above draining into it, the other below drinking from it—do you know any instances of disease propagated from the former to the latter through the medium of the river water? Do you know any facts showing the propagation of typhoid, or scarlet fever, through potable water?

An adjourned meeting of the Association will be held on Saturday, May 1st, when the discussion will be resumed on Dr. Letheby's paper "On the Methods of Estimating Nitrogenous Matters in Potable Waters, and on the Value of the Expression '*Previous Sewage Contamination*' as used by the Registrar-General in his Monthly Reports of the Metropolitan Waters."

The chief points for consideration in the paper are the following:—1st. Whether rivers fouled by sewage and manufacturing refuse have or have not a self-purifying power. 2nd. Whether the nitrogenous compounds of river and well waters must necessarily have a previous sewage or manure origin. 3rd. Whether, in describing the analytical facts of water examinations, it is proper to use such a speculative phrase as "Previous Sewage Contamination," and to express the result in tons.

Royal Society.—At the President's second soirée, at the Royal Society, on April 24th, 1869, Mr. John Browning, of the Minorities, exhibited the following novel instruments:—

New Electric Lamp, in which both carbons are moved by the electricity without clockwork.

New Polarising Saccharometer, proposed by Dr. Dupré. This instrument shows the amount of sugar in a solution by a change in the position of a line in the spectrum.

An improved Spectroscope, in which the dispersion may be instantly doubled, or trebled, without changing any of the adjustments.

A new Direct Vision Pocket Spectroscope; containing seven prisms, and an achromatic lens. This instrument will show the absorption bands in coloured fluids, the bright lines in the spectra of metals and gases, and all the principal lines in the solar spectrum.

Professor Graham's discovery, the absorption of hydrogen by palladium; a very compact apparatus for showing the expansion of a piece of palladium by the absorption of the gas, contrived by Mr. Chandler Roberts and Mr. John Browning.

The Zirconia Light.—I learn that the oxyhydrogen zirconia light has been such a success at the Tuilleries, having been worked without interruption since the 21st of January, that the Emperor has ordered measures to be taken to render that mode of illumination permanent in front of his palace. During the interval required for getting these new arrangements ready, the court will be lit up with ordinary gas as before. In connection with this fact, M. Tessié du Mothay has had the Order of Chevalier of the Legion of Honour bestowed upon him, and well has he merited it for his many useful and practical inventions. Whether the process introduced by this gentleman for the commercial manufacture of oxygen from the manganates is the best that can be used for the purpose may, perhaps, be open to discussion; this, at any rate, is true, that it is the only process that has succeeded on a large practical scale up to the present time.—*British Journal of Photography*.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

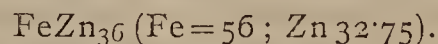
Analysis of the Celebrated Aventurin Glass made at Venice.—Dr. Salvieti.—(*Pharm. Zeitschr. f. Russland*, No. 2, 1869.)—In 100 parts:—Silica, 67.3; alumina, 9.0; peroxide of iron, 3.4; oxide of tin, 2.3; oxide of lead, 1.0; metallic copper, 4.0; potassa, 5.3; soda, 7.0.

On the Solubility of Iodine and Sulphur in Petroleum.—Dr. Th. Koller.—(*Neues Jahrb. f. Pharm.*, vol. xxxi., No. 2, 1869.)—One part of iodine requires for its solution, at a temperature of 17° C., 145.6 parts of petroleum, and 1 part of sulphur (as so-called flowers sulphur), requires at the same temperature 158.4 parts of petroleum.

Curiously-Petrified Wood.—(*Journ. f. Prakt. Chem. v. Erdmann*, No. 1, 1869.)—Dr. Oudemans, jun., has had the opportunity of analysing some pieces of wood from the *Colbertia ovata*, a tree indigenous to Java, which wood, on being placed in a certain stream in that island, becomes rapidly and thoroughly petrified, so as hardly to be distinguishable from sandstone; but microscopic research detects the organic structure. The air-dried wood leaves 1.9 per cent of ash of the following composition in 100 parts:—Silica, 58.8; phosphoric acid, 1.8; carbonic acid, 8.6; oxide of iron, 1.5; alumina, trace; oxide of manganese, 0.1; lime, 12.8; magnesia, 2.7; potassa, 11.3; soda, 1.8. The petrified wood was composed of—silica, 98.0; phosphoric acid, oxide of iron, and alumina, together, 1.3; lime, a trace; organic matter and water, 0.7. It is not quite possible to explain what causes this curious change, unless there were an opportunity to obtain and analyse the water, wherein the petrifying process goes on (as is said by the natives) very rapidly.

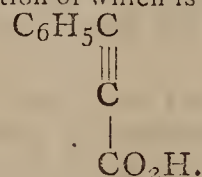
Analysis of Smalt.—(*Journ. f. Prakt. Chem. v. Erdmann*, No. 1, 1869.)—Under this name is known a blue pigment largely used on the Continent; the sample, of which the result of analysis is here quoted, was as beautiful as best artificial ultramarine. In 100 parts:—Silica, 63.7; oxide of lead, 2.7; protoxide of cobalt, 5.7; potassa, 20.1; alumina, 4.0; oxide of iron, 1.3; water, 1.7. Not a trace of protoxide of nickel was found.

On an Alloy of Iron and Zinc.—(*Journ. f. Prakt. Chem. v. Erdmann*, No. 1, 1869.)—It is a well-known fact that iron is dissolved by molten zinc, but nowhere is any definite alloy of these metals described, nor is it also stated how much iron is dissolved by zinc. Dr. Oudemans, jun., obtained for analysis a piece of metal which had been formed in an iron vessel wherein zinc had been fused for several weeks continually; this metal was found deposited at the bottom of the vessel, and became an impediment to the melting operations in consequence of the relative infusibility of the alloy. In physical aspect this latter was of very much whiter colour, and entirely different crystalline structure than zinc; the alloy dissolved very readily and briskly in dilute sulphuric or hydrochloric acid, and was found, on analysis, to contain 4.6 per cent of iron. Taking for granted that this alloy is a definite compound of the two constituent metals, its formula would be—

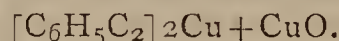


Analysis of Two Kinds of Labradorite.—(*Journ. f. Prakt. Chem. v. Erdmann*, No. 1, 1869.)—Dr. Oudemans, jun., analysed two varieties of this mineral—one violet-coloured, the other white and non-transparent. Violet variety in 100 parts:—Silica, 56.21; alumina, 29.19; oxide of iron, 1.31; lime, 11.14; magnesia, 0.51; soda, 1.37; potassa, a trace; loss on ignition, a trace; total, 99.73. White variety in 100 parts:—Silica, 58.1; oxide of iron and alumina, 27.9; lime, 9.4; magnesia, a trace; soda, 5.1; total, 100.5.

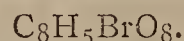
Researches on some Derivatives from Cinnamic Acid.—C. Glaser.—(*Zeitschr. f. Chem. v. Beilstein, &c.*, vol. xii., No. 4, 1869.)—The author has, in a former notice, spoken of an acid containing H_2 less than cinnamic acid; that acid has been called by him phenylpropionic acid, the constitution of which is represented by—



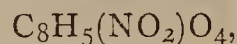
The author further states that, by taking CO_2 from this acid, he would be enabled to form a new hydrocarbon, which would stand in the same relation to acetylen as styrol stands to ethylen. This new hydrocarbon is named acetylenylbenzol; this material is a colourless highly refrangible fluid, having a peculiar odour, and boiling at 140° ; vapour density, 3.7; formula, C_8H_6 . It is readily decomposed by nitric and sulphuric acids. It combines with copper, forming a compound—



Bromophthalic and Nitrophthalic Acids.—Faust.—(*Zeitschr. f. Chem. v. Beilstein, &c.*, vol. xii., No. 4, 1869.)—The author prepared, for some other researches, bromo and nitrophthalic acids. The former is represented by—



In the pure state it is a white crystalline powder readily soluble in water, alcohol, and ether, and fuses between 136° and 138° C., without giving off vapour of water; it forms salts with bases. Nitrophthalic acid—

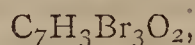


is obtained when phthalic acid is digested with a mixture of equal parts of red fuming nitric acid and sulphuric acid; the mixture is left for twenty-four hours to itself, and then treated with water and purified by making a potash salt of the newly-formed acid, and this is decomposed by means of sulphuric acid. Nitrophthalic acid crystallises from ether in straw-yellow prisms, is soluble in water and ether, and fuses at 208° C. This acid also forms salts very readily.

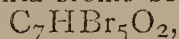
Mono- Tri- and Penta-bromo-benzoic Acid.—Reinecke.—(*Zeitschr. f. Chem. v. Beilstein, &c.*, vol. xii., No. 4, 1869.)—When bromine acts upon benzoic acid, water being present and a higher temperature applied, the above-named bromo-benzoic acids are obtained. The mono-bromic acid—



is difficultly soluble in water, crystallises, and fuses at 152° C.; the tri-bromo-benzoic acid—



is also a solid crystalline substance, hardly soluble in boiling water, and fuses at 235° C.; the penta-bromo-benzoic acid—



is also a solid, soluble (as are also the two preceding) in weak alcohol, and fuses at the same temperature as the tri-bromo-benzoic acid. All these acids readily enter into combination with lime, forming regular and well-defined salts.

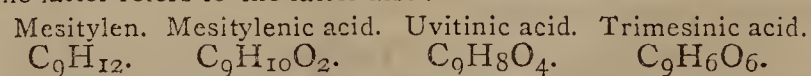
Results of Analyses of Compressed Peat from Switzerland.—Dr. Goppelsroeder.—(*Chem. Centralbl.*, No. 11, 1869.)—The air-dried substance contained in 100 parts:—Water, 23.17; ash, 7.87; carbon, 40.09; hydrogen, 4.53; oxygen, 21.50; nitrogen, 2.84. The material submitted to elementary organic analysis had been dried at 120° C. The ash contained chiefly sulphuric acid, lime, alumina, peroxide of iron, and silica; also chlorine, soda, magnesia, and traces only of phosphoric acid.

On the Lowering of Temperature due to the Solution of Salts in Water.—Fr. Rüchhoff.—(*Berichte d. Deutschen Chem. Gesellsch. z. Berlin*, No. 4, 1869.)—The decrease of temperature will be the greater the larger the quantity of any salt which water takes up at a certain given temperature. Since, however, water at a certain temperature only dissolves a definite quantity of any salt, the maximum decrease of temperature will be about that at which, under given circumstances, a fully saturated solution is produced. When, therefore, the salt and the water are applied in the proportion wherefrom a saturated solution results, a long period of time elapses before the last portions of the salt are entirely dissolved, and the effect of the warm ambient air to some extent vitiates the proper results of the experiments; the saturated solution should therefore be obtained as rapidly as possible. The experiments were conducted in the following manner:—The finely-powdered salt and the requisite quantities of water were, previous to the making of the experiments, each put in separate beakers made of very thin glass, and placed for from 12 to 18 hours in a room wherein the temperature could be kept as nearly as possible constant; in consequence of this the beakers and contents attained the same temperature throughout. The mixing was effected by pouring the water on to the salt, and stirring up with a very delicate and highly-sensitive thermometer; the maximum decrease of temperature took place within a minute after the mixing of the salt and water was made. The results of the experiments are exhibited in the following tabulated form, recording the average of a series of several experiments with one and the same substance, which were concordant within 0.2° :—

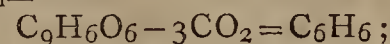
	Soluble in 100 parts of water.	Mixed with 100 parts of water.	The temperature falls		Number of Degrees.
			From $^\circ$ C.	To $^\circ$ C.	
Crystallised alum ..	10.0	14	+10.8	+9.4	1.4
Chloride of sodium ..	35.8	36	12.6	+10.1	2.5
Sulphate of potassa ..	9.9	12	14.7	+11.7	3.0
Crystallised phosphate of soda ..	9.0	14	10.8	+7.1	3.7
Sulphate of ammonia ..	72.3	75	13.2	+6.8	6.4
Sulphate of soda (crystals) ..	16.8	20	12.5	+5.7	6.8
Sulphate of magnesia (crystals) ..	80.0	85	11.1	+3.1	8.0
Carbonate of soda (crystals) ..	30.0	40	10.7	+1.6	9.1
Nitrate of potassa ..	15.5	16	13.2	+3.0	10.2
Chloride of potassium ..	28.6	30	13.2	+0.6	12.6
Carbonate of ammonia ..	25.0	30	15.3	+3.2	12.1
Acetate of soda (crystals) ..	80.0	85	10.7	−4.7	15.4
Chloride of ammonium ..	28.2	30	13.3	−5.1	18.4
Nitrate of soda ..	69.0	75	13.2	−5.3	18.5
Hypsulphite of soda (crystals) ..	98.0	110	10.7	−8.0	18.7
Iodide of potassium ..	120.0	140	10.8	−11.7	22.5
Chloride of calcium (crystallised) ..	200.0	250	10.8	−12.4	23.2
Nitrate of ammonia ..	55.0	60	13.6	−13.6	27.2
Sulphocyanide of ammonium ..	105.0	133	13.2	−18.0	31.2
Sulphocyanide of potassium ..	130.0	150	10.8	−23.7	34.5

The quantity of water applied varied between 250 and 500 grammes, and the quantity of salt used corresponded therewith. The decrease of temperature obtainable in this manner can never fall below the freezing point of the saline solution in question, but can very nearly reach that. The sulphocyanide of potassium is the best salt to be adopted for the artificial production of ice; when 500 grammes of this salt are dissolved in 400 cubic centimetres of water, and the mixture stirred with a test-tube filled with water, the latter will be frozen in from two to three minutes. The degree of solubility of the salts referred to in the first column is made up according to G. J. Mulder's highly elaborate researches on this subject.

On Mesitylen.—(*Journ. f. Prakt. Chem. v. Erdmann*, No. 1, 1869.)—This is best prepared from acetone, by allowing it to be left first for twenty-four hours in contact with sulphuric acid diluted with half its bulk of water, and proceeding to the distillation of the mixture; after that time, in this manner a larger quantity of raw produce is obtained, which is next rectified by distillation over sodium. Treated with strong nitric acid, mesitylenic acid is produced, which forms, with bases, well-defined salts. Among the products of oxidation of mesitylen belong uvitinic acid and trimesinic acid, while mesidinic acid is an intermediate product. The following formulæ refer to these products, mesidinic and uvitinic acids being proved to be identical; the formula for the latter refers to the latter also:—



Uvitinic acid is a solid substance, difficultly soluble even in boiling water, but readily so in alcohol and ether; it fuses at 288° C., sublimes without decomposition, and is a bibasic acid which readily forms salts with bases. Trimesinic acid, when distilled with excess of lime, yields chiefly benzol—



this acid is consequently a benzol wherein for 3H has been substituted 3COHO.

Obtaining Coke quite free from Sulphur.—(*Moniteur de l'Indre France*).—The coke made in the usual manner is placed in an apparatus wherein it is heated at a temperature of about 300° C., and simultaneously submitted to the action of a strong current of atmospheric air compressed to between two and three atmospheres (30 to 45 lbs. to the square inch). By this means the sulphur is converted into sulphurous acid, and that gas removed by the strong current of air. Analysis of coke, before and after having been submitted to this process, proves:—(a) Not a trace of sulphur is left in any form in the coke submitted to the described treatment; (b) all the iron previously existing in the coke as sulphide has been converted into peroxide; (c) the calorific power of the desulphurised coke has become greatly increased, and is at least one-fourth more than that of ordinary coke; (d) experiments conducted on the large scale at iron works have proved that the coke treated as described produces iron as good in quality as that obtained with wood charcoal.

Preparation of Uric Acid from Peruvian Guano.—Dr. J. Löwe. —(*Les Mondes*, No. 14, 1869).—In order to prepare uric acid from this material on the large scale, take equal weights of sulphuric acid and guano; heat the sulphuric acid in a porcelain basin placed on a water-bath, put the previously well-dried and ground-up guano, dried at 100° C., little by little into the acid, taking care to stir up the mixture with a glass rod, since during this operation much carbonic acid and hydrochloric acid gas are given off. It is necessary to perform the operation either in the open air or under a chimney hood with a good draught; as soon as the reaction ceases, dilute with from ten to twelve times its bulk of distilled water. A yellow precipitate soon ensues, and it is therefore preferable to perform the dilution, not in a basin, but in a cylinder glass. The precipitate having settled, the supernatant liquid is decanted, the precipitate first washed by decantation, and afterwards collected on a filter and washed until the sulphuric acid is nearly all removed; the precipitate is then, little by little, added to a boiling weak alkaline solution, and the uric acid precipitated from the alkaline fluid by means of hydrochloric acid. The crude uric acid thus obtained is purified by the processes of either Wöhler or Heintz.

On the Action of Penta-Chloride of Phosphorus upon Saccharine Substances.—A. Baeyer. —(*Berichte d. Deutschen Chem. Gesellsch. z. Berlin*, No. 3, 1869).—When grape sugar is boiled with a mixture of penta-chloride of phosphorus, oxychloride of phosphorus, and water, an amorphous, colourless, flocculent matter is formed, which dissolves in water on boiling; this indicates either the formation of an anhydrous substance or of a chloride; since, however, the sugar is, while being thus treated, readily decomposed, and this decomposition accompanied with a brownish colouration, the reaction cannot be satisfactorily studied. Cotton wool behaves, when treated with the same substances, in a similar manner; when gun cotton, however, is heated up to 200° C. in a mixture consisting of six parts of pentachloride of phosphorus and some oxychloride of phosphorus, the gun cotton is entirely dissolved in the latter substance without any decomposition. When the oxychloride and pentachloride of phosphorus are dissipated by evaporation by means of a current of air heated to 170° C., there is left a thick colourless liquid which, on cooling, leaves a brittle gum-like mass; this substance is soluble in ether and alcohol, and insoluble in water, but on being boiled therewith decomposition ensues and a viscous substance remains. When the gum-like mass is treated with solution of caustic potassa, and heated therewith, it becomes brown; on being heated with hydriodic acid, iodine is separated. The substance in question appears to be a chloride of cellulose or of sugar, somewhat resembling the chlorides of mannite.

NOTES AND QUERIES.

Aluminium Bells.—It appears that some Belgian manufacturer has just had a bell cast of aluminium, and with very good results. It is of course extremely light, so that, though large, it can be easily tolled; its tone is reported to be loud and of excellent pitch. Aluminium is the most sonorous of all metals.—*Engineer*.

Carbonic Acid.—Do you see any objection to common washing soda as a source of carbonic acid? I have used it now for years, and find it a very great convenience. There is a total absence of fumes, as I use sulphuric acid and water; there is an abundant supply of gas, and, above all, there is very rapid production, so desirable in class experiments. Still, as none of "the books" mention it, I hesitate to teach that soda is a better carbonate to use than marble or chalk. In one of his Christmas lectures (*CHEMICAL NEWS*, xix., 101), Dr. Odling coloured the gas brown. How is that to be done?—E. KERNAN.

"How to Prevent the Spread of Scarlet Fever."—A few weeks ago, some suggestions on the above subject appeared in a medical paper, and were reprinted in a leading journal; the idea of the writer was that the plentiful use of "green copperas" as a disinfectant, would prevent the spread of fever; the germs of which, from the drains, often penetrate into the wells and contaminate the drinking water. Allow me to ask a question, with reference to the plan above stated. This disinfectant is, I believe, a poison; and is there not danger from its infecting the water? If so, the remedy would be as bad as the evil that is sought to be cured. I throw out the hint, only suggesting the question for discussion, and not pretending to give any opinion upon it: it is a matter, however, well worthy the attention of your readers.—SANITAS.

Mutual Decomposition.—Analysis of Sewage.—About forty years ago, researches were made concerning the first part of this query by Dr. G. J. Mulder. The printed memoir containing the result of

these researches is out of print. But the precise answer to this somewhat complicated subject, depends on the conditions under which the salts are brought together; also, whether or not organic matter is present. The presence of the silicate of alumina, and of the peroxide of iron, has very little, if any, influence at all. There are plenty of excellent treatises on analytical chemistry, published in various languages, the titles of which "W." may be informed of by any bookseller. There is no necessity to specify any of these books in our pages.

Safety Matches.—It is well known that serious accidents occur from fire, caused by persons carelessly throwing down matches, which they believe to be harmless because the flame has been extinguished, but which, in reality, are highly dangerous, and quite capable of communicating fire to any light, dry material, in consequence of the wood splint being at a red heat, although not actually in flame. It has been proposed, in order to prevent this, to saturate the splints, previously to their being dipped, with a solution of some chemical salt which has the property of preventing the wood from remaining at a red heat after the flame has been extinguished, without being in any way detrimental to the inflammable nature of the splint, and thus to prevent the possibility of accident from the dropping of the match after the extinction of the flame, but while the splint is still at a red heat. The substance which it is proposed to employ is alum, though other salts have the same property. The matches, before being dipped, are to be immersed in a strong solution of alum, or other salt with similar action, until they are saturated; they are then to be dried and tipped with the ordinary composition. Matches, so treated, are said to ignite and burn with flame as long and as readily as other matches; but the instant the flame is blown out the match becomes black and perfectly harmless.—*Scientific American*.

On Luteine and the Spectra of some Yellow Organic Substances.—By luteine, Dr. Thudicum understands a yellow crystalline substance occurring in various parts of animals and plants, as, for instance, the *corpora lutea* of ovaries, serum of blood, yolks of eggs, in seeds, as maize (Indian corn), in annatto, in carrots, and the stamens and petals of a great many flowers. Luteine is easily soluble in alcohol, ether, and chloroform, insoluble in water; these solutions are yellow, but that in chloroform, when concentrated, has an orange-red colour. Spectrum of solutions is distinguished by great brilliancy of the red, yellow, and green part, and by three absorption bands, which are situated in the blue, indigo, and violet part of the spectrum. The crystals of luteine are apparently rhombic plates, of which two or more are always superposed in a curious manner. The crystals are microscopic, yellow when thin, orange to red when thick, and have no resemblance to any other known animal or vegetable substance. Luteine combines with few substances, mercury-acetate being, perhaps, the only reagent by which it is immediately and completely precipitated as a yellow deposit; mercury-nitrate produces a yellow precipitate which, on standing, becomes white. Nitric acid poured over the crystals, produces a blue colour, which immediately passes into yellow. The blue is not produced when nitric acid is added to either the alcoholic, ethereal, or chloroformic solution of luteine, but appears with the acetic acid solution and disappears again rapidly. Luteine has great affinity for fatty matters and for albumine.

Sulphide of Carbon Light.—Mr. D. Winstanley describes (in the *British Journal of Photography*) an apparatus consisting of a water-bath heated by a Bunsen gas burner; within the water-bath is placed a vessel, to hold disulphide of carbon. The outer and inner vessels are firmly soldered together, and proper arrangements are made to enable the experimenter to pour water in the outer vessel, which is also provided with a neck to hold a thermometer, serving to indicate when the temperature at which the bisulphide of carbon contained in the inner vessel boils. The inner vessel is provided with a neck, closed by a well-fitting cap when the apparatus is in use, for the introduction of the fluid bisulphide of carbon; beside this, there is soldered to the inner vessel a gas-pipe of small bore, which pipe projects at a convenient height above the outer vessel; to this pipe is soldered and connected at right angles another pipe, provided with a stop-cock, and further connected, by means of elastic tubing, with a gas-holder containing oxygen gas made from chlorate of potash. After the application of gas-flame beneath the water-bath, the thermometer is watched, until it indicates that the vapour of the bisulphide of carbon is issuing from the burner (from the gas-pipe connected with the inner vessel); the heat is allowed to continue beneath the water-bath until the flame reaches the flaring point, when it is lessened almost to extinction. The oxygen gas is then cautiously introduced, upon which the flame at once diminishes in size and increases greatly in brilliancy. This light is proposed for use in photography on account of its great actinism; as a source of intense heat it may also, perhaps, be recommended.

NOTES ON LECTURE EXPERIMENTS.

New Carbonic Acid Generator.—This is but a modification of the spongy platinum hydrogen lamp, but the modification renders it very useful as a quick producer of gas on the lecture table. As in the hydrogen lamp, there are two receivers, one standing in the other: it is in the inside receiver that the charges are made. For the lump of zinc of the lamp is substituted a tray of perforated lead, with a rod, by which to hang in the receiver. A bit of lead is joined to the bottom of the tray (outside) to serve as a handle, when it is to be put into, or removed from, the receiver. The tray has three feet, which leave space for the handle, and allow the liquid to drain off well. For use, the tray is filled with soda crystals, and hooked into the receiver; acid and water put into the outer receiver. The action is now just that of

the hydrogen lamp. One tray-full of soda is quite enough for a long series of experiments, but if more be required, in a minute the tray is taken out, emptied, and re-filled with crystals. Evidently this apparatus is just as useful for hydrogen production. The tray will hold a large quantity of granulated zinc, and with strong solution a steady flow will be kept up, with the cock full open. The other day, when putting by this apparatus, I observed for the first time, an interesting example of a heavy body floating. Crystals of soda, even very large, floated to the top of the acid solution, supported, I presume, by the evolution of gas. The soda could not be less dense than the solution. The crystals first fell to the bottom and then rose to the surface. It is, however, evident that the solution must have a certain strength; for I tried a second solution, and in this only small crystals floated: tested with a hydrometer, the second solution was less dense than the first.—
E. KERNAN.

MEETINGS FOR THE WEEK.

- MONDAY, May 3rd.—Royal Institution, 2. General Monthly Meeting. Medical, 8.
- TUESDAY, 4th.—Royal Institution, 3. Professor Grant, "On Stellar Astronomy."
- WEDNESDAY, 5th.—Society of Arts, 8.
- THURSDAY, 6th.—Royal Institution, 3. Professor Tyndall, "On Light."
— London Institution, 6.
— Chemical, 8. J. Lowthian Bell, Esq., F.C.S., "On the Chemistry of the Blast Furnace."
- FRIDAY, 7th.—Royal Institution, 8. Capt. Moncrieff, "On the Moncrieff System of Working Artillery."
— Geologist's Association, 8.
- SATURDAY, 8th.—Royal Institution, 3. Prof. Seeley, "On Roman History."

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THE CHEMICAL NEWS.

VOL. XIX. No. 492.

SPECTROSCOPIC OBSERVATIONS OF THE SUN.

By J. NORMAN LOCKYER.*

No. IV.

I BEG to lay before the Royal Society very briefly the results of observations made on the 11th inst. in the neighbourhood of a fine spot, situated not very far from the sun's limb.

I. Under certain conditions the c and F lines may be observed *bright on the sun*, and in the spot spectrum also, as in prominences or in the chromosphere.

II. Under certain conditions, although they are not observed as bright lines, the corresponding Fraunhofer lines are blotted out.

III. The accompanying changes of refrangibility of the lines in question show that the absorbing material moves upwards and downwards as regards the radiating material, and that these motions may be determined with considerable accuracy.

IV. The bright lines observable in the ordinary spectrum are sometimes interrupted by the spot spectrum, *i. e.* they are only visible in those parts of the solar spectrum near, and away from, spots.

V. The c and F lines vary excessively in thickness over and near a spot, and on the 11th in the deeper portion of the spot they were much thicker than usual.

VI. Stars, in the spectrum of which the absorption lines of hydrogen are absent, may either have their chromospheric light radiated from beyond the limb just balanced by the light absorbed by the chromosphere on the disk, or they may come under the condition referred to in II., either absolutely or on the average.

ON THE

COMPOSITION OF THE MILK OF THE SOW.

By Professor CHARLES A. CAMERON, Ph.D., M.D.,
Analyst to the City of Dublin.

WITH the exception of the milk of the sow, the lacteal secretions of the domesticated animals have been repeatedly analysed. Scheven appears to have been the only chemist who has published an analysis of sow's milk; but his results are so different from those of an analysis of sow's milk made by myself that I am induced to publish my analysis. In the sow's milk examined by me there was 6 per cent of fat, whilst in a specimen analysed by Scheven, the proportion of that constituent was under 2 per cent. It is not very easy to procure a specimen of sow's milk, and perhaps this is the reason why it has not hitherto been frequently analysed. I endeavoured on several occasions to obtain a small quantity, but the sows appealed to at my instigation were obdurate—they would not yield a drop, even when subjected to the dexterous manipulation of the most skilful dairymaids. At length, about two months ago, a specimen of sow's milk came into my possession; I am indebted for it to Thomas Baldwin, Esq., the Superintendent of Irish Agricultural Schools, and Director of the Glasnevin Government Model Farm. On submitting it to analysis, the following results were obtained:—Specific gravity, 1.041; colour, white, without any bluish shade; flavour very rich, resembling

that of the skimmings of cow's milk; reaction, very faint alkaline. 100 parts contained:—

Water	.. .. .	81.80
Fats	.. .. .	6.00
Casein and other nitrogenous matters		5.30
Lactin	.. .. .	6.07

Mineral matter 0.83

100.00

Total solids 18.20

The analysis was conducted as follows:—

a. A weighed portion of the milk was acidulated with a little acetic acid to prevent the formation of a skin, mixed with pulverised quartz (which had been previously boiled in hydrochloric acid, washed, and ignited) and evaporated in the water-bath to dryness.

b. The residue was treated with strong ether, by which the fats were dissolved. The ether was then evaporated and the residue of fats weighed. The fats were finally burned in a platinum capsule, and left no residue, proving the absence of mineral matter or casein.

c. The substance from which the fats had been removed was subjected to a nitrogen combustion, and from the amount of nitrogen obtained the proportion of casein and other nitrogenous substances present in the milk was estimated in the usual manner.

d. The proportion of lactin was found by difference, and also by the sulphate of copper method.

e. Determination of the mineral matter (ash). Five grammes of the milk were evaporated to dryness and the residue burned in oxygen gas. The amount of solid matter obtained by desiccating a weighed quantity of milk was slightly in excess of the sum of the weights of the individual constituents. It must, however, be borne in mind that the mineral matter in the nitrogenous substances is weighed twice—first, as a constituent of the casein, and, secondly, as an ingredient of the ash. Its amount, however, is trifling.

A comparison of the milk of the sow with that of the cow and other animals will show how extremely rich is the former.

Composition of the Milk of different Animals.

1,000 parts contain:—

	Water.	Butter.	Cheesy Matter.	Sugar.	Mineral Matter.
Woman	889.08	26.66	39.30	43.68	1.30
Cow	864.20	31.30	48.80	47.70	6.00
Goat	844.90	56.87	35.14	36.91	6.18
Ewe	832.32	51.31	69.78	39.43	7.16
Mare	904.30	24.36	33.35	32.76	5.23
Ass	890.12	18.53	35.65	50.46	5.24
Sow	818.00	60.00	53.00	60.70	8.30

Proportions of Solids and Water in different kinds of Milk.

	Woman.	Cow.	Goat.	Ewe.	Mare.	Ass.	Sow.
Water	889.08	864.20	844.90	832.32	904.30	890.12	818.00
Solids	110.92	135.80	155.10	167.68	95.70	109.88	182.00
	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00

The following particulars relative to the sow whose milk I have described were furnished to me by Mr. Baldwin:—"The sow whose milk I sent you is a pure Berkshire; she had pigged six days before the milk was withdrawn; she has a fair litter, and is an average nurse. She is receiving the sort of diet suited to her condition—viz., a mixture of small and damaged potatoes, pulped roots, and a little grains, the potatoes and roots being subjected to the action of steam. The food is not too rich, but just sufficient to keep herself and her young in a good healthy condition."

Pig's milk is extremely rich, containing, as it does, nearly 50 per cent more nutritive matter than is found in that of the cow. It is not unlikely that in certain forms of disease where a milk diet is prescribed the use of so concentrated a liquid food might prove serviceable.

102, Lower Baggot Street, Dublin.

* Read before the Royal Society, April 28th, 1869.

ON SOME APPLICATIONS OF ELECTRICITY TO NAVAL AND MILITARY PURPOSES.*

By F. A. ABEL, F.R.S., For. Sec. C.S.

THE applications which electric science has received within the last few years in connection with the military and naval services are various and important. The employment of the electric light for signalling and reconnoitring purposes; the permanent establishment of telegraphic equipments by which an army in the field or at a siege is maintained in the most intimate communication with the directing powers; the employment of electric signalling arrangements in ships of war, and the accurate investigation of the ballistic force of gunpowder and other explosive agents, are among the uses to which electricity has been put in connection with war purposes; but the earliest application, and one of the most important and extensive—one, moreover, possessing great interest from industrial points of view—is the employment of electricity as an agent for exploding land- and submarine mines.

The possibility of applying the electric spark to the ignition of charges of gunpowder suggested itself both to Franklin, in 1751, and to Priestley in 1767; but it was not until some years after the discovery of the electric pile by Volta, that serious attempts were made to apply electricity to mining and military purposes. The first practical application of the voltaic battery in this direction was made little more than thirty years ago by French military Engineers; a few years afterwards that agent was successfully applied in this country in connection with important blasting operations, such as the destruction of Round Down Cliff at Dover, and the removal of the wrecks of the *Royal George* and *Edgar* at Spithead. The general method of operation then pursued was adhered to by military Engineers in this country until very recently, and is, in fact, still occasionally employed, though it has been in great measure superseded by other systems which present very important advantages. It consists in inserting into the charge of gunpowder a short piece of thin wire, composed of a metal of inferior conducting power, such as iron or platinum, and placing this wire into connection with the circuit wires of the battery. The resistance offered to the passage of the current gives rise to the development of heat, the intensity of which is regulated by the conducting power and the length and thickness of the wire. The latter may, in this way, be raised to a red heat, or even fused; and thus, by completing circuit through the wire at the desired moment, a charge of powder may be inflamed. A number of charges may be simultaneously exploded by introducing several pieces of thin wire into the circuit.

Although the employment of a voltaic current of low tension presents obvious and great advantages over old systems of igniting charges by trains or slow-burning fuses, its application to military purposes is attended with some difficulty and uncertainty, arising out of the want of uniformity of action of the same voltaic arrangements at different periods, the difficulties attending the transport and proper preservation of the battery and materials required for its use, the dependence for success upon care and experience in preparing and preserving the batteries, and the very considerable increase which it is necessary to make in the power of the battery when the operations to be performed involve the simultaneous explosion of a number of charges, or the ignition of gunpowder at very considerable distances from the battery.

For these reasons, soon after the first successful application of voltaic electricity to mining purposes, the attention of military Engineers on the Continent, and of others here and abroad who were specially interested in operations of this kind, became directed to the possibility of rendering

electricity of high tension available for exploding purposes, whereby voltaic batteries, for mining operations, might be greatly reduced in size, if not altogether dispensed with.

In 1853, a Spanish officer, Colonel Verdu, associated himself with M. Ruhmkorff in experiments on the application of electro-magnetic induction coils to the explosion of gunpowder. The success of their experiments led Colonel Verdu to pursue them further in Spain, where he soon succeeded in firing six mines simultaneously by one element of Bunsen's battery, at a distance of upwards of three hundred yards, through the agency of the Ruhmkorff coil. The mode of operating and difficulties which Colonel Verdu had to overcome will be presently described. While the success of these operations led the military Engineers in Spain, France, and Russia to pursue the development of the application of electro-magnetic induction instruments to exploding purposes, a committee of Austrian military Engineers (of which Baron von Ebner was from the first a most distinguished member) was labouring to apply frictional electricity to military uses as an exploding agent, having come to the conclusion that the electro-magnetic induction apparatus was too complicated and too greatly susceptible of derangement for military uses. But little success had up to that time attended attempts to apply frictional electricity to this purpose. In 1831, Moses Shaw, of New York, succeeded in exploding several mines simultaneously by means of frictional electricity, but was foiled in his attempts to apply this agent to practical purposes, by the fact that he could not conduct operations with any chance of success except in very dry weather. Somewhat more promising results attended several attempts in Germany between 1842 and 1845; but the prospect of practical success was still not encouraging when the Austrian Committee of Engineer Officers took the matter in hand, and eventually produced a portable glass frictional electric machine, which, when in good working order, furnished results surpassing those which had been obtained with volta-induction apparatus. Some very extensive operations were conducted with this machine; thus, fifty land charges and, afterwards, thirty-six submarine charges, were simultaneously exploded. Even, however, with all the precautions adopted, the machine was still too seriously affected by damp to be thoroughly serviceable for military purposes. But the persevering labours of Baron von Ebner eventually resulted in the production of an electric machine which was almost entirely free from the objections hitherto attached to this form of apparatus.

While the progress just indicated was being made in different parts of the Continent in the application of electricity to mining operations, but little attention was directed in this country to effecting improvements in the utilisation of electricity for military mining purposes. In 1855, however, Sir C. Wheatstone directed the attention of Field-Marshal Sir John F. Burgoyne to the importance of instituting an experimental inquiry into the relative advantages of different sources of electricity of tension as agents for exploding gunpowder. The Ordnance Select Committee, of whom Sir C. Wheatstone and Mr. Abel were then members, were consequently instructed to pursue this inquiry; and a series of investigations was carried out, in the first instance, to a working branch of the Committee, and subsequently by Mr. Abel at Woolwich and Chatham, the results of which were eventually embodied in a report presented by the above-mentioned gentlemen to the Secretary of State for War in 1860. Since then Mr. Abel, as a member of the Government Committee on Floating Obstructions, has continued systematic investigations on the applications of electricity to the explosion of mines, and especially to submarine operations, and considerable improvements and simplifications of the arrangements and appliances have resulted. Some advance has also been made on the Continent in this subject, and during the last two or three years our military Engineers have acknowledged in the most practical manner the advantages to be derived from the use of

* A lecture delivered before the Royal Institution of Great Britain, March 12, 1869.

electricity of tension as the agent for exploding mines, by gradually and to a very great extent abandoning the old system of operation, and by devoting considerable attention to the practical elaboration of the new systems.

The following is an outline of the results obtained up to the present day with different classes of instruments which furnish electricity of tension.

It has been stated that Colonel Verdu succeeded, in 1853, in exploding several mines simultaneously by means of a Ruhmkorff induction coil. The ignition of the gunpowder was effected in these experiments by introducing one or more small but complete interruptions into the circuit, across which the electric spark of high tension would leap upon the current being passed. This spark will inflame gunpowder, but not very readily, although its production is attended with development of heat considerably in excess of that required; the reason being that powder requires for ignition either the close proximity of a considerable heated surface, or the continuous application to heat for a brief period, while the disruptive discharge from an induction coil consists of a series of instantaneous discharges following each other in very rapid succession. Hence a charge of gunpowder is not always instantaneously fired when the spark is passed; indeed, unless the powder be closely confined round the wire terminals between which the spark passes, it is sometimes dispersed by the mechanical action of the spark without being exploded; and when a succession of sparks is passed simultaneously through a number of charges, it frequently happens that only a few are exploded, in which some of the grains happened to be in positions or conditions more favourable with reference to the source of heat than in other instances, where the powder would escape ignition. Colonel Verdu succeeded in increasing the certainty of simultaneous ignition of several charges, by surrounding the wire terminals with a substance much more readily inflamed than powder—the fulminate of mercury. Another source of difficulty in effecting the simultaneous ignition of a considerable number of charges by the spark from the coil is the enfeebling effect upon the spark-discharge exerted by a number of successive small interruptions in the circuit. This was to some extent overcome by employing a fuse constructed by Messrs. Statham and Brunton, in which the space between the wire terminals was bridged over with a film of a finely-divided substance—the subsulphide of copper—the conducting power of which is sufficiently great to aid the passage of the electric discharge across the interruption, while it is at the same time readily combustible, and therefore directly promotes the ignition of the powder. Finding that, even with the combined use of this fuse and of fulminate of mercury, the power of the induction coil to explode charges simultaneously was limited, Colonel Verdu adopted the following simple arrangement:—Separate small groups of mines were all connected with earth, and an insulated conducting wire connected each group with a distinct small insulated plate. By bringing these plates in very rapid succession into circuit with the coil machine, the several groups were so rapidly exploded as to produce results somewhat similar to those attainable by the really simultaneous discharge of a considerable number. Not long after this contrivance was adopted by M. Verdu, M. Savare devised another arrangement, whereby a much more rapidly successive discharge of a number of mines was accomplished through the agency of the coil. The metallic circuit which passed to the mines was divided into a number of branches, so that, upon completion of the circuit, the currents, following each other in very rapid succession, would distribute themselves through all the branches with a degree of uniformity regulated by the resistance met with in each branch. Thus, when one or more fuses were interposed in each branch of the circuit, those which happened to offer the greatest facilities for the passage of the current would be first fired, whereupon the escape of electricity in that direction would be interrupted, and the explosion of fuses in the other branches would follow. With the employ-

ment of currents following each other with the enormous rapidity with which they pass off from the induction coil machines, the discharge of a number of mines may thus be effected with a rapidity which, practically, has almost the effect of a simultaneous discharge.

The Ruhmkorff coil was used to some extent by the Russians in mining operations during the Crimean war, and some very extensive blasting operations were carried on with its aid at Cherbourg in 1854. A series of experiments was instituted at Woolwich in 1856 with two excellent induction coils, produced by M. Ruhmkorff, in the course of which various descriptions of materials were tried in the fuses, for the purpose of increasing the power of the machine to fire numbers of charges simultaneously. At that time the fulminate of mercury was found to be the best inflaming agent; but not more than twelve charges were fired simultaneously by means of the most powerful coil available and a battery of twelve cells (without employing Verdu's or Savare's methods of explosion). One defect in this class of instrument was found to be the want of uniform action of one and the same apparatus at different periods; another was the liability to derangement of the machine, especially of the condenser. Far more successful results were afterwards obtained with the same coils and the fuse constructed at a later period of these investigations; fifteen charges were fired simultaneously with a battery of six cells and fifty charges, arranged in branch-circuit in groups of ten, were exploded with the effect of a simultaneous discharge. These results were obtained with machines produced by Ruhmkorff in 1855; but the improvements since then effected in the construction of this apparatus have reduced to insignificance the results at that time obtained with it. There is no question therefore that the Ruhmkorff coil is available for special operations of considerable magnitude; but in point of simplicity, certainty, and constancy of action, it is far surpassed by other forms of electric instruments, which will be presently noticed.

At the suggestion of Sir Charles Wheatstone, experiments were commenced in 1856 on the application of currents induced by permanent magnets to the explosion of gunpowder. The first experiments were instituted with a very large and powerful magneto-electric machine, constructed by Mr. Henley, of which the armature, carrying two powerful coils, was suddenly detached from the magnet by means of a lever. A few experiments sufficed to show that the induced current obtained even with this powerful instrument was not adequate to ignite one single charge of gunpowder with certainty. Somewhat better, but still uncertain, results were obtained with Statham's and one or two others forms of fuses existing at that time. A careful investigation was then undertaken by Mr. Abel (with the invaluable assistance of Mr. Brown, of the Chemical Department, Woolwich), into the conditions to be fulfilled in the production of a fuse which should be certain of action with the magneto-electric machine. The results of extensive experiments indicated that a combination of comparatively high conducting power with great susceptibility to ignition appeared to be essential elements of success in a material to be used as the exploding agent in a fuse. The uniform arrangement of the poles or wire terminals in the fuse, the space between which was to be bridged over by the igniting composition, also proved a matter of great importance. A mode of constructing the fuses which ensured perfect uniformity in this respect was ultimately perfected, and has proved quite successful. A very fairly efficient fuse was obtained with the aid of the poles thus arranged, by employing as the igniting agent gunpowder impregnated with a small proportion of calcic chloride, which caused it, upon brief exposure to air, to imbibe moisture sufficient to render the gunpowder highly conducting. It is obvious, however, that, although the fuse itself was hermetically closed when complete, there must be a liability to want of uniformity in the proportion of water absorbed by the powder, and a consequent variation in the conducting power of the latter. Eventually a

material was prepared (consisting of the subphosphide of copper, subsulphide of copper, and potassic chlorate) which combined the essentials of perfect certainty of action with very great sensitiveness to ignition. Henley's large magnet fired *three* of these fuses simultaneously with perfect certainty, while a small horse-shoe magnet with revolving armature exploded 25 in divided circuit in exceedingly rapid succession. A combination of six small compound magnets was afterwards employed, with which an exceedingly rapid succession of currents was obtained, and this apparatus exploded twenty-five fuses in divided circuit with a rapidity which to the ear had the effect of an instantaneous explosion. Even the small magneto-electric instruments which are used for medical purposes will explode these fuses with certainty.

The application of magneto-electric machines having been successfully accomplished, a series of experiments was carried on by Mr. Abel, with the valuable aid of Colonel H. Scott, R. E., at Chatham, during the years 1857-58, on the explosion of charges, both land and submarine; and the great advantages of these instruments, as regards simplicity and permanent efficiency, over the voltaic arrangements hitherto used, was fully demonstrated. Very compact but powerful exploding instruments were constructed by Sir C. Wheatstone, and these have for the last seven or eight years received many important applications; thus, the proof of cannon at Woolwich and the firing of guns, from a safe distance, in the numerous experiments at Shoeburyness, is effected by means of Wheatstone's exploder, which is, moreover, an important adjunct in all electro-ballistic experiments, when the operator desires himself to fire a gun at a particular moment. Magneto-electric machines have also been found very useful in connection with blasting operations on land, except in instances when the absolutely simultaneous explosion of a large number of mines is required.

Since the success of Wheatstone's exploders has been fully established, several other forms of magneto-electric machines have been devised, especially on the Continent and in America. Powerful instruments similar to Wheatstone's are manufactured by Siemens and Halske, of Berlin; Markus, of Vienna, has constructed very efficient instruments in which one separation and return of the armature to the magnet are made to explode the charges. The disadvantages of these instruments is that a *succession* of currents cannot be obtained from them as in the case of machines with revolving armatures; hence the number of mines which can be exploded by them in divided circuit is comparatively limited. Mr. Beardslee, an American, has also devised a modification of Wheatstone's exploder, in which the magnets are made to revolve between the armature coils, and which furnishes currents of greater quantity but lower tension than Wheatstone's. The fuse constructed by Mr. Beardslee, for employment with this instrument is similar in principle of construction to Abel's; but the materials which bridge over the space between the terminals or poles of the fuse are black-lead, with the addition of a minute quantity of some substance, apparently collodion, which adds to the size of the scintillations produced when the current passes, and thus increases the certainty of ignition of the powder which is in close contact with the poles. These fuses are efficient with magneto-electric instruments like that of Mr. Beardslee, but they are much less delicate than the Woolwich fuses, and the number which can be simultaneously exploded is therefore much more limited. Sir C. Wheatstone has also lately constructed more powerful modifications of his original magnetic exploder, which may, at will, be made to furnish currents of greater quantity and lower tension, or to produce the high tension currents. Lastly, Mr. Ladd and Mr. Browning have produced instruments of comparatively low price, but quite powerful enough for ordinary blasting and quarrying operations. The only obstacle, but a most important one, to the general use of these machines, for the explosion of mines on land and under water is, that very slight defects in the insulation of

the conducting wire which leads from the instrument to the mines are quite fatal to its exploding power. In consequence of the high tension of the current developed by these machines, and the small quantity put into circulation by even the most powerful of them, the diversion of the current from its destined course to earth is promoted by the smallest points of escape presented to it; a result which is, moreover, facilitated by the resistance of the fuses in circuit. With care this source of failure can be guarded against in operations on land, but such is not the case with regard to submarine arrangements; while, moreover, minute defects in the coatings of the *submerged* wires, which would hardly influence the results at all on land, completely nullify the exploding power of the machines. Hence magneto-electric instruments are the least reliable of all electric exploding apparatus for submarine purposes.

A few experiments were instituted at Woolwich in 1857 on the employment of *frictional electricity* as an exploding agent, and especially with a small hydro-electric machine constructed for the purpose by Sir William Armstrong. As regards its power of exploding a number of charges simultaneously, when it was in good working order, it far exceeded any other instrument experimented with at that time: one hundred fuses, arranged in a single current, were frequently exploded by its means; but the great uncertainty of its action, and the difficulty of employing it in the field did not afford encouragement for a continuation of experiments with it.

The great difficulties encountered in the Austrian experiments in the attempts to employ glass frictional electric machines as exploding agents for military purposes, led Baron von Ebner to direct his attention to the production of an instrument in the construction of which glass was altogether avoided, and which might therefore be expected to be less subject to atmospheric influences. His labours in this direction were eventually crowned with success; for he found in the hard vulcanised india-rubber (known as ebonite or vulcanite) a dielectric material excellently adapted to the construction of the frictional apparatus; while by employing a sheet of vulcanised india-rubber coated with tinfoil and compactly rolled up he obtained without the use of glass a powerful condenser, or Leyden jar arrangement. The improved machines were constructed in a very compact form (with cases excluding all the working parts from direct exposure to air) by Messrs. Siemens, of Berlin, and Lenoir, of Vienna, who exhibited specimens in England in 1862, at which time the electric machine had already received important applications in the Austrian service, and had been regularly adopted for military uses. Baron von Ebner had also, from the commencement of the Austrian experiments, laboured assiduously at the production of an efficient fuse to be used with electricity of tension; and the Austrian service is indebted to him for a simple and thoroughly serviceable fuse, which, as regards the arrangement of its poles and the character of the igniting composition, may be said to combine the principles of the Statham and Abel fuses. Though less sensitive than the present English service electric fuse, a very considerable number may be exploded in simple circuit by the ebonite electric machine. The power of this apparatus in its portable form is nearly equal to that of the hydro-electric apparatus just now referred to, when the latter is in perfect working order. A far greater number of mines may therefore be simultaneously exploded by its means than by very large batteries or by the most powerful magneto-electric machines hitherto constructed. One hundred of Abel's fuses have frequently been simultaneously exploded with one of the portable machines, and still greater results can be obtained with a larger instrument having a battery of condensers, which was specially constructed for submarine operations by Mr. Becker, at the suggestion of Captain Maury. In very damp weather, when the most perfect glass electric machines would have been useless unless housed in a warm apartment from which the external air was as

much as possible excluded, these ebonite machines have been used from time to time throughout the day with very satisfactory results.

Another important advantage which these instruments possess over magneto-electric machines consists in the fact that very considerable defects in the insulation of even submerged conducting wires do not so greatly reduce the power of the current furnished by them as to interfere with the accomplishment by its agency of the most extensive operations under water which are likely to occur in practice. Unfortunately, however, the very circumstance which constitutes its chief advantage, namely, the powerful character of the current of high tension with which it charges an insulated wire, is also a source of serious defect, to be presently noticed, which very greatly limits the applicability of these machines to naval and military purposes.

(To be continued).

ON THE
ESTIMATION OF COPPER IN ORES,
BY CERTAIN METHODS FOR WHICH A PREMIUM HAS BEEN
AWARDED.*

(Concluded from p. 209.)

Estimation of Copper in the Mansfeld Ores, according to the Method proposed by M. C. Luckow, at Deutz.

FOR a few years, the gentleman just named has applied to the quantitative estimation of copper present in salts, alloys, and ores, a new method, based upon the precipitation of the metal in metallic state, from solutions containing either free sulphuric or nitric acids, by means of a galvanic current.

It is a great advantage of this method, that, while the copper is precipitated, it is simultaneously separated from metals with which it is often found alloyed, some of which, such as tin and antimony, are separated by treatment with nitric acid in an insoluble form, while others, like silver, can easily be removed in the form of chloride. It is, at the same time, another advantage that the state in which the copper is obtained, admits of its being accurately weighed and estimated, while a great number of operations, which require much time and various apparatus, is, at the same time, got rid of.

Although, already some four years ago, M. Luckow had discovered a method of electro-metallic analysis from fluids containing free sulphuric acid, his researches on the same subject, in the case of free nitric acid, belong to a later period. These researches brought very unexpectedly to light the curious fact, that even a weak galvanic current had the power to completely precipitate copper in a pure metallic state, from solutions which did not contain more than 0.1 grm. of anhydrous nitric acid to the c.c. (nitric acid of 1.2 sp. gr. contains 0.32 grm. of anhydrous nitric acid to the c.c.), while it was, at the same time, found that the action was more regular, and less dependent upon the power of the current than when free sulphuric acid was present. The following more commonly occurring metals are *not* precipitated by galvanic action from acid solutions:—Zinc, iron, nickel, cobalt, chromium, the metals of the earths, and alkalis. There are precipitated—

(a). In the shape of peroxides, at the positive electrode: completely, lead and manganese; incompletely, silver. When the solution contains traces of manganese, it becomes, in consequence of the formation of a salt of peroxide of manganese, or permanganic acid, deeply violet coloured. This very sensitive reaction for manganese also takes place when small quantities of chlorine are present. The presence in the fluid of oxalic, lactic, and tartaric acids, and other readily oxidisable organic substances, and such protoxides as are readily peroxidised—

for instance, protoxide of iron—retard the formation of peroxides, as well as the setting-in of the reaction of manganese.

(b). Precipitated at the negative electrode in metallic state, are mercury, silver, copper, and bismuth. When mercury is present in the solution simultaneously with copper, the former metal is separated before the latter, in the fluid metallic state. As soon, however, as the precipitation of copper commences, there is, when mercury is also present, formed an amalgam of the two metals. Silver is precipitated almost simultaneously with copper; bismuth only begins to be precipitated after the greater portion of the copper has been already separated. A complete separation of silver only ensues when some such substance as tartaric, or any other similar acid is simultaneously present in the solution. The separation of the three last-named metals, by means of galvanic action, is, therefore, unsuccessful; but, fortunately, we have plenty of other means to accomplish this end completely.

(c). Metallic arsenic is only precipitated slowly; and long after the complete separation of copper, is the former metal separated from arsenic acid, if it should happen to be present. The same remark applies to antimony, since it is well known that small quantities of antimonious acid are soluble in nitric acid.

The operations, according to Luckow's plan, are—
I. Roasting of the ore; II. Solution of the roasted product; III. Precipitation of the copper; IV. Weighing of the copper.

I. *Roasting of the Ore.*

Care should be taken to obtain a finely-ground, average sample of the ore. M. Luckow then weighs off, in previously accurately counterpoised small porcelain capsules, quantities of from 1 to 3 grms; these quantities are then placed on the inverted lid of an iron crucible, on the inner surface of which the powdered ore is heated, over the flame of a Bunsen gas-burner. The powder may be carefully stirred up with a platinum wire, to promote the access of air during the roasting, and the ignition of bituminous matter and sulphur may be ended in about seven minutes. Ores which do not contain bitumen at all need not be roasted.

It has been already stated that, especially as regards poor copper ores (and those of the Mansfeld district are generally so), the quantities to be weighed off for assay should not vary according to a presumed percentage of copper. One gramme is too small a quantity; 2 grms. are now taken, and, instead of roasting the ore on the lid of an iron crucible, small porcelain crucibles are applied for that purpose.

II. *Solution of the Roasted Product.*

According to M. Luckow's plan, the iron lid is suffered to cool, the roasted powder placed on a piece of glazed paper, and any powder adhering to the lid is removed by means of a camels-hair brush, on to the paper. The powder is next transferred to small beaker glasses, and some 2 or 3 c.c. of nitric acid, of 1.2 specific gravity, are added, along with about 10 to 15 drops of concentrated sulphuric acid. The beakers are then placed on a sand-bath, and moderately heated, at first; but when the contents have nearly become dry, the heat is increased, so as to evaporate and expel all sulphuric acid. The beakers should be covered with perforated watch glasses. This operation requires from about three-quarters to one hour. The addition of sulphuric acid is made in order to increase the oxidising action of the nitric acid, and also to convert any lime which may happen to be present in the ore into a difficultly soluble salt. It is very useful, also, to add some 10 or 20 drops of hydrochloric acid to the mixture of the two acids just alluded to, since the rapidity of the evaporation is thereby increased, and the occasional spitting about of the fluid is lessened.

The process just described is modified, of course, first by the use of porcelain capsules, the contents of which

are easily transferred to beakers with flat bottoms, and not higher than about 2 inches in all. It is better, also, to use a sulphuric acid, prepared of equal bulks of concentrated acid and water, and to measure off 4 c.c. for each assay; while for each assay, moreover, 6 c.c. of nitric acid, and about 25 drops of hydrochloric acid are taken. Instead of covering the beaker with a perforated watch glass, a funnel is used, as represented in Fig. 1; with this arrangement, the sulphuric acid evaporates far more readily, and loss by spiriting is prevented. The beaker is heated on a well-arranged sand-bath.

III. Precipitation of the Copper.

As soon as the beaker-glass, after removal from the sand-bath, has become quite cool, the funnel which has been used as a cover is washed on both sides, inner and outer, with nitric acid of 1.2 sp. gr., diluted with six times its bulk of pure water; the sides of the beaker are next likewise washed, and the latter filled to about half its height

FIG. 2.



FIG. 1.

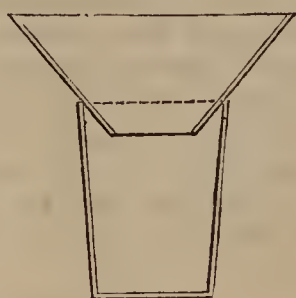


FIG. 4.

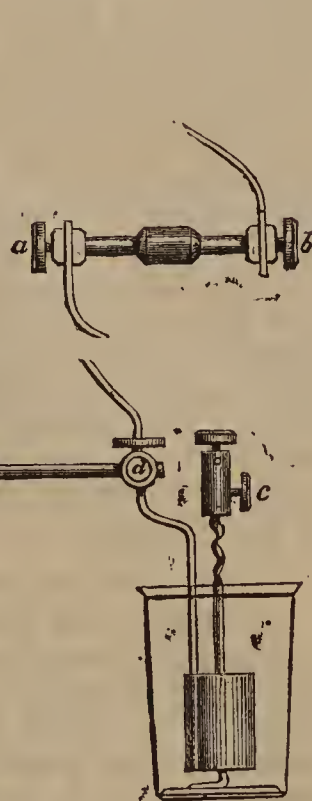
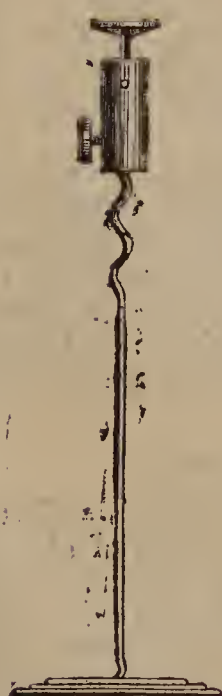


FIG. 3.



solution of nitrate of baryta may be added, and the thorough mixing of this saline solution with the acid contents of the beaker promoted, by gently moving up and down the platinum spiral just alluded to, and allowing the fluid to rest for a few minutes after. The copper present in the mass left at the bottom of the beaker gradually dissolves; and it is not actually requisite to wait for applying the galvanic current until it is all dissolved.

The next point is to place in the beaker the platinum foil, represented at Fig. 3, of which the dimensions are—length, $2\frac{1}{2}$ inches; width, $1\frac{1}{4}$ inches. The lower end of this platinum foil should be left about $\frac{1}{16}$ th of an inch apart from the convolutions of the spiral. When the beaker is only half filled with liquid, the platinum foil is immersed in the same for more than three-fourths of its height. The wire fastened to the said foil is fixed, by means of a screw *a*, to the arm *ab* of the stand, represented at Fig. 4; the other screw, *b*, serves to fasten a copper wire, proceeding from the zinc plate of the galvanic battery. When the small screw clamp *c* (Fig. 4) has been fastened to the platinum wire placed in the beaker, another wire is fastened in the top opening of the clamp just referred to, and this wire connected with the copper plate of the battery, and the galvanic circuit thus closed. In a few moments after this has been done, the platinum foil, bent in the shape of the cylinder and placed inside the beaker, as before described, will be observed to become covered with a coating of metallic copper, while from the platinum wire spiral bubbles of gas escape, which facilitate, to some extent, the solution of the oxide of copper in the dilute acid.

In order to ascertain whether the whole quantity of the copper has been precipitated, some more dilute nitric acid is added to the fluid in the beaker-glass. If, in ten minutes after this, no more metallic copper is separated on the clean portions of the platinum foil, the operation is finished.

It is to be here observed that continued practice has proved that the addition of a concentrated solution of nitrate of baryta acts injuriously on the process, in so far as the metallic copper, which becomes separated, gets mixed with some insoluble sulphate of baryta, which increases the weight of the substance to be weighed. The cylinder made of platinum foil, should not be at a greater distance from the platinum spiral wire than about $\frac{1}{16}$ th of an inch.

The time occupied by the complete precipitation of the metal varies according to the force of the galvanic current. It varies in duration from three to even eight hours. In order to make this point certain, all test assays are left for eight hours consecutively, in contact with the galvanic current, experience having proved that, after that lapse of time, even with a weak current, the precipitation was so complete that all chemical reagents, even the most delicate, for detecting copper, failed to discover even the most minute trace of that metal.

IV. Weighing the Copper.

According to M. Luckow's plan, the platinum cylinder to which the copper adheres, and the platinum wire spiral are disconnected from the galvanic apparatus, the platinum cylinder carefully removed from the beaker and immediately plunged into a beaker filled with fresh cold water, and rinsed therein; next washed with alcohol, by means of a washing bottle, and then dried in a drying apparatus, and weighed after cooling. Since the platinum cylinder had been very accurately weighed *before* the experiment, its increase in weight will, of course, be that of the copper obtained.

The process here described has been somewhat modified and greatly improved upon at Eisleben, where it is in constant use, by means of a series of galvanic elements. It is, in the first place, found better not to disconnect the galvanic current while yet the copper is in contact with acid, so that, instead thereof, the acid fluid in the beaker is replaced by running in a stream of water, and suffering the same to run over the sides of the beaker, and to be

with the same acid. A few drops of a concentrated solution of tartaric acid are added (which acid, by the bye, is best kept in solution in open vessels, only slightly covered with a piece of paper); this having been done, the wire spiral, represented in Fig. 2, is carefully placed into the beaker-glass. This spiral consists of a piece of platinum wire, about $\frac{1}{12}$ th of an inch thick, and $7\frac{1}{2}$ inches long, while two-thirds of its length is so wound that the straight end of the wire projects as if it were the axis of the centre of the spiral. The convolutions of the spiral are so large that they touch the sides of the beaker, while the straight portion just touches the centre of the bottom of the vessel.

When the heating has been carefully attended to, the acid fluid added to the contents of the beaker, after evaporation to dryness, will generally be quite clear; if it happens to be turbid, 1 or 2 c.c. of a concentrated

received into a proper vessel to hold it. In this manner all the acid is displaced, without risk of any very small quantity of copper becoming acted upon by the acid during the brief period lapsing between the disconnecting of the galvanic current and the removal from the beaker of the platinum cylinder and spiral wire. These parts, on being removed, are carefully washed, first with boiling water, next with alcohol, and then dried, at a temperature of about the boiling point of water. The cylinder is then weighed, and, after that, the copper coating is removed therefrom, by means of nitric acid; next washed in water, dried, and again weighed.

There are in use at Eisleben nine galvanic batteries (lead and zinc elements); these yield eighteen assays ready for weighing in twenty-four hours. It would be easy for the person there employed to work with twelve batteries each of three elements. The results obtained are highly satisfactory. The following observations may be made in reference to this method:—

(a). The quantity of ore taken for trial is 2 grammes, and is found sufficient, while it consumes less acid.

(b). The evaporation of the acid is carried on to complete dryness on the sand-bath. Spiriting of the fluid is easily prevented; when the copper has been precipitated properly it will show its peculiar colour on the surface, and the good success of the operation may be judged from the fact, also, that no saline matter adheres to the platinum; the complete absence of which saline matter has been found to be evidence of complete removal of the copper from the fluid.

The process just described is especially applicable and useful for rather poor ores, such as do not contain above 7 or 8 per cent of copper. Each assay, from beginning to end, takes ten hours for complete analysis; but it is evident that the longer portion of this period is such as does not give active employment to the assayer. The expense of working this process, after the apparatus have been once purchased, is very small indeed. The process may be applied to analyse rather rich ores, and also of alloys of copper, with some slight modifications, which require attention, especially, also, if silver should happen to be present.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Annual Meeting, Saturday, May 1st, 1869.

Sir HENRY HOLLAND, Bart., M.D., D.C.L., F.R.S.,
President, in the Chair.

THE Annual Report of the Committee of Visitors for the year 1868 was read and adopted.

The books and pamphlets presented in 1868 amounted to 116 volumes, making, with those purchased by the managers, a total of 220 volumes added to the library in the year, exclusive of periodicals.

Fifty new Members were elected in 1867.

Sixty lectures and twenty evening discourses were delivered during the year 1868.

Thanks were voted to the President, Treasurer, and Secretary, to the Committees of Managers and Visitors, and to the Professors, for their services to the Institution during the past year.

The following gentlemen were unanimously elected as officers for the ensuing year:—

President—Sir Henry Holland, Bart., M.D., D.C.L., F.R.S.

Treasurer—William Spottiswoode, Esq., M.A., F.R.S.

Secretary—Henry Bence Jones, M.A., M.D., F.R.S.

Managers—George Berkley, Esq., C.E.; William Bowman, Esq., F.R.C.S., F.R.S.; Charles Brooke, Esq., M.A.,

F.R.S.; George Busk, Esq., F.R.C.S., F.R.S.; Adm. Sir Henry John Codrington, K.C.B.; Warren De la Rue, Esq., Ph.D., F.R.S.; John Peter Gassiot, Esq., F.R.S.; John Hall Gladstone, Esq., Ph.D., F.R.S.; Wm. Robert Grove, Esq., M.A., Q.C., F.R.S.; George Macilwain, Esq.; The Duke of Northumberland; William Frederick Pollock, Esq., M.A.; Robert P. Roupell, Esq., M.A., Q.C.; The Hon. John William Strutt; Colonel Philip James Yorke, F.R.S.

Visitors—Andrew Whyte Barclay, M.D.; Charles Beevor, Esq., F.R.C.S.; John Charles Burgoyne, Esq.; Sir C. Wentworth Dilke, Bart.; Alfred Gutteres Henriques, Esq.; Sir Thomas Henry; Thomas Hyde Hills, Esq.; Thomas Lee, Esq.; William Longman, Esq.; Edward Henry Moscrop, Esq.; Rev. Cyril W. Page, M.A.; Edmund Pepys, Esq.; The Lord Joceline W. Percy; Arthur Giles Puller, Esq., M.A., F.S.A.; Robert Ballard Woodd, Esq., F.S.A., F.R.B.S.

General Monthly Meeting, Monday, May 3rd, 1869,

Sir HENRY HOLLAND, Bart., M.D., D.C.L., F.R.S.,
President, in the Chair.

THE following Vice-Presidents were nominated for the ensuing year:—The Duke of Northumberland; William Spottiswoode, Esq., F.R.S., the Treasurer; J. P. Gassiot, Esq.; and George Busk, Esq.

Lieut.-Colonel Archibald Campbell Campbell; Sir William Dickason Clay, Bart.; William Wilbraham Ford, Esq.; John Benjamin Marsden, Esq.; and Herbert Schloss, Esq., were elected Members of the Royal Institution.

John Tyndall, Esq., LL.D., F.R.S., was re-elected as Professor of Natural Philosophy.

The Managers announced that, in conformity with the deed of endowment, they had appointed Michael Foster, M.D., F.L.S., Fullerian Professor of Physiology.

FRENCH ACADEMY OF SCIENCES.

Monday, April 26th, 1869.

A communication was read from the REV. FATHER SECCHI, S.J., "*On the Spectroscopic Phenomena of the Sun's Spots*" recently observed by him; he finds that the spectra of these spots present great analogy with those of the stars known as Arcturus and Aldébaran. He also mentions that the different spots he had the opportunity to examine on the sun's disc exhibit differences identical to those which characterise the spectroscopical appearances of the stars.

During the proceedings of this meeting, at which no papers or communications on chemistry were sent in, several papers were read, and a long discussion ensued, on the aurora-borealis alluded to in our last report of the meetings of this scientific body; it appears that the phenomenon has been observed even in the southern parts of France, while perturbations of magnetic instruments have been reported from Leghorn as well as from Greenwich.

A discussion, wherein M. Sainte-Claire Déville took a prominent part, on the changes produced in the weather, barometric pressure, and temperature subsequent to the observation of the aurora-borealis, led to no definite result as far as the fixing of causes and effects in this matter is concerned.

M. L. Hugo, from Versailles, addressed a note "*On the Construction of a Synoptic Pyrhelioscope*," by means of which instrument it would be possible to see all the solar protuberances at the same time; the instrument is intended to be a spectroscope to which, by means of suitable clock-

work, an angular motion may be imparted. The note and description were handed over to a committee to report thereon.

Two papers relating to electricity were read, but as both belong rather to the domain of higher mathematical physics, they are unfit and too abstruse for abstraction in our pages.

NOTICES OF BOOKS.

A History of Chemical Theory from the Age of Lavoisier to the Present Time. By AD. WURTZ, Membre de l'Institut (Académie des Sciences). Translated and Edited by HENRY WATTS, B.A., F.R.S. London: Macmillan and Co., 1869. Pp. 220, 8vo.

OUR readers will recognise under the above title the "Discours préliminaire" which constitutes a kind of preface to M. Wurtz's "Dictionnaire de Chimie" now publishing in France. A work in the English language, and specially devoted to chemical history, appears so seldom in this country, that we purpose commenting upon it at somewhat greater length than the intrinsic merits of the book might appear to demand.

M. Wurtz's *history* commences with a brief introduction, which is followed by four chapters in which attention is directed to the respective doctrines of Lavoisier, Dalton and Gay-Lussac, Berzelius, and Laurent and Gerhardt. Another chapter is devoted to the discussion of existing theories; and this is followed by a few explanatory notes, to which the editor has judiciously added.

The opening sentences of the introduction are not likely to meet with very general acceptance among chemists who are acquainted, even but a little, with the development of existing doctrines. That "chemistry is a French science," and that "it was founded by Lavoisier," are two propositions which reduce the whole subject, not only to a nationality, but to an individual, and neither of these propositions has any historical foundation whatever. We also feel bound to deny—in language no less decided than that of M. Wurtz, who affirms that, for ages preceding Lavoisier, chemistry "had been nothing but a collection of obscure and often fallacious receipts"—that Lavoisier's system was more scientific than that of Stahl, and that Lavoisier was "the creator of the true method in chemistry." Claims of this character invariably carry a doubtful appearance, and even a general reader would hesitate to admit them. It is surprising that M. Wurtz, in his zealous and just endeavour to honour the memory of a truly great man, should estimate the labours and ideas of the ancients at so paltry a value; for, considering how little real novelty can be attributed with certainty to the French chemist, and how much he derived from his immediate and remote predecessors, Lavoisier himself is the only loser by the comparison. It must not be forgotten, however, that we are dealing with a traditional method. No sooner had Lavoisier formed in his own mind a clear conception of the plan he was about to pursue, and collected a few able associates around the regal standard, than he boldly named his system "French Chemistry." There was much art in that designation. In the first place he made interest with the vanity of his nation; in the second, he ignored antiquity; and, lastly, he thereby ensured the perpetuation of his personal fame. This title, however,—the sagacity of which we cannot but admire—was accompanied by a great deal of practical arrogance. Chemistry in France, instead of following its own natural development, was dispensed by a despot and his courtiers. In Germany the schools were insulted by the information that Stahl, their common and respected master, was destitute of common sense, and his theory of phlogiston a delusion; so that we cannot much wonder at the slowness with which the new system crossed the Rhine. In England it soon found powerful (and, perhaps, too partial)

advocates, though even some of these were offended at Lavoisier's dictatorial manner and disingenuousness.

It has always been admitted, and we think with much correctness, that Lavoisier's achievements are all connected very intimately with the study of oxygen. No one could have better pointed out the logical value of his deductions, or the admirable sequence of his reasoning, than M. Wurtz has done in this volume. But we owe the discovery of oxygen to Priestley and Scheele; that it constitutes a part of the air, and is the one important agent both in combustion and calcination were facts known to Hooke [whose name is omitted from this chapter]. The increase in weight of metals when calcined had been acknowledged, we need hardly say, long before Lavoisier. Cavendish and Watt were the first to ascertain the composition of water. Black established the doctrine of latent heat (which is left unnoticed here). These are the essential, indeed the only, bases of Lavoisier's system. What, then, becomes of the statement that "chemistry is a French science?" Surely Davy was well warranted in saying "his discoveries were few, but he reasoned with extraordinary correctness upon the labours of others." Lavoisier's merit rests in the circumstance that he combined the scattered links which we have mentioned into a firm and single chain; not in the deceptive supposition that he inaugurated a new era. As an innovator he failed entirely. Few conceptions could be more gross or retrograde than that of oxygen as the acidifying principle, or (as he at one time conjectured) than that of nitrogen as the alkalisng principle. It is clear, in fact, that the general acceptance of Lavoisier's system by his contemporaries depended on the very circumstance that it was, in its separate details, essentially old and not new.

We must not omit to notice the stress that many writers have laid upon the quantitative character of Lavoisier's experiments, involving, as it is commonly believed, the first introduction of the balance into chemistry. This fallacy is very well exposed by Mr. Watts, who, in a note at the end of the volume, gives a detailed account of Black's famous research on the nature of mild and caustic alkalis. Professor Wurtz, who is silent on this point, certainly mentions the memorable analyses of Wenzel, and the philosophic intention with which they were undertaken; but why the German chemist should be said to have "toiled in the dark" (*travaillait obscurément*) does not altogether appear, unless we are to allow that the brilliant Frenchman involved his contemporary in a total eclipse. Strictly speaking, the idea of weight does not possess so great a value as is commonly assigned to it, and a science of chemistry might very well exist without that idea as a factor. The broader and necessary conception of *number* was, in reality, and in this respect, what Lavoisier so eminently aided in announcing. That the notion of the indestructibility of matter even presented itself to his mind as a clear inference is very improbable, or, at least, an open question.

The study of the functions of oxygen had naturally led Lavoisier back to dualism; that is to say, he had re-established, but on a wider experimental basis, the fundamental conception which we owe to the iatro-chemists. Thoroughly conscious of the true value of language, he added to the maxims of Condillac the practical efforts of Morveau. Morveau was induced to abandon the phlogistic doctrine; a committee was appointed with Lavoisier at its head, and a nomenclature soon appeared from which the name of phlogiston was absent, and which embodied the spirit of the rising school. That nomenclature was undoubtedly a great success in its time, and its establishment was justified on principles to which few will deny either wisdom or foresight.

The idea of number soon assumed a very important phase in connection with chemistry. The law of multiple proportions, first observed by Higgins, and re-discovered by Dalton fifteen years subsequently, received, at the hands of the latter philosopher, an interpretation in accordance with the ancient notion of atoms. Higgins re-

presented these atoms as held together by mutual forces symbolised by lines. Dalton employed in his lectures a wooden sphere with radiating spokes. The modern notion of atomicity (if any clear notion really exists on such a subject) has, therefore, a somewhat remoter parentage than is commonly assigned to it. The announcement and gradual acceptance of the atomic theory mark especially an influx of materialism which has already reached its highest point, and is now commencing to recede from the steady shore of philosophic thought. M. Wurtz speaks strongly in praise of Dalton, whose name, he says, "is one of the greatest in chemistry," and points out, also, in this chapter the well-known relation between Gay-Lussac's great discovery and that of his English contemporary. The parts taken respectively by Avogadro and Berthollet on the latter question are also very clearly and excellently stated, but, perhaps, a little too briefly.

Berzelius adopted the atomic theory, but did not contribute to it any modification of serious importance. His quantitative work, though, doubtless, suggested by that theory, is, in its results, quite independent of any theory. Like Lavoisier's, his system was essentially dualistic, but his dualism was in many points different from, and superior to, that of his French predecessor, and had the advantage of reposing on a purer dynamics. The "binary theory," as it has been termed, was hardly ripe for discussion when a warm controversy took place between Berzelius and the French school led by Dumas. But we must refer the reader to M. Wurtz's book for a detailed and lively account of the campaign. The disorder, confusion, and misapprehension of the real question at issue have certainly not been surpassed in scientific history. Berzelius originated our present symbolic system, and the nomenclature which he had introduced, revived as it has been by Williamson, is gaining favour in this country.

The next chapter is devoted to an account of the doctrines of Laurent and Gerhardt. How far these great men, whose names will be for ever united in one dualistic formula, ever really adopted the atomic theory, is somewhat difficult to ascertain, and was, perhaps, unknown to themselves. That they protested against any representation of atomic arrangement is certain; but they adopted atomic language on many occasions. The doctrine of types and the numerical criteria of formulæ largely occupied their attention, but the idea of Gerhardt's "series" was borrowed from Avogadro.

M. Wurtz's final chapter is devoted to a lengthy discussion of the theories which prevail at the present day; their immediate origin and interdependence are pointed out with great clearness and force. It is stated, and with much truth, that these theories are essentially atomic; and the author, who has himself largely contributed to their success, of course heartily supports them. We do not propose to criticise them in this place, for such a procedure would hardly fall within the province of a contemporary reviewer, but content ourselves with warning students to suspend their judgment upon any corpuscular doctrine until they are really able to decide upon it for themselves. The influences of atomicism are so subtle that, if once committed to their acceptance, it is almost impossible for any mind to effect an escape.

We cannot, in conclusion, refrain from expressing our thanks to M. Wurtz for an account of chemical history in which, though some serious errors occur, there is so much to gratify and attract. The style is so lively and energetic, the argument so deductive, and the meaning so unmistakable, that we cannot help feeling how great a contribution has been made towards satisfying a real want of our time; and we commend the work to our readers with all the more confidence, because the editing and translation have been so judiciously executed. The notes which Mr. Watts has added are, moreover, evidences of the importance which he is well known to attach to an impartial statement of facts, and will serve to remedy some of the faults we have alluded to. Chemical literature in England

owes a fresh debt to Mr. Watts, and we sincerely hope that his edition of M. Wurtz's *discours préliminaire* will aid in reviving a taste for a neglected but most important branch of literature.

CORRESPONDENCE.

EQUIVALENCE AND QUANTIVALENCE.

To the Editor of the Chemical News.

SIR,—As an admirer of the logical and very appropriate moderation evinced by the President in the discussion at the last meeting of the Chemical Society, I would moot that Mr. Ward's attack is not altogether in good taste; his long letter of nearly three columns is a reiteration of the "Hofmann" text without a single emendation or improvement. He may write grandiloquently of the all-important and momentous law of quantivalence; but Chemistry is making progress, and since the work of Hofmann newer and profounder treatises have appeared with admissions that may well justify the humble and cautious attitude referred to.

It is not true that the doctrine of equivalents only leads to the question *How much?* for it equally embraces the *How many?* Nor is it at all denied the full benefit of volumetric guidance, with all other physical and chemical aid.

What more does the momentous law of quantivalence provide? Mr. Ward says that N is trivalent. Mr. Equivalent says that in relation to H it is trivalent or triatomic; but is it so essentially or *per se*? Mr. Ward says not! Is the trivalent or "equiquantic" nitrous acid the most definite or stable of its oxy-combinations? Mr. Ward says not! Is this momentous law in any way the expression of chemical force or "chemism?" Mr. Ward says not!

Is S'O'' equiquantic? Because, as that is the weakest of its principal forms of combination, peradventure quantivalence may be a law of weakness.—I am, &c.,

CHEMICUS.

MISCELLANEOUS.

On the Use of Tungstate of Baryta in Painting.—(Extract from a letter from M. Sacc to M. Dumas.)—"At the request of a landscape painter, I was induced to examine in succession all our insoluble white compounds, with regard to their adaptability to painting purposes. Tungstate of baryta answers perfectly, covers as well as white-lead, and as is unalterable as zinc white. It has been employed by this artist for three months, and was found equally successful in oil or water colours, chromolithography, and even in making white impressions on a black ground. This harmless substitute for the injurious white-lead is prepared on a large scale in Paris by M. E. Rousseau."

Extraction of Oxygen from the Air.—There is a competitor in the field now, in the shape of a process for extracting the oxygen from the air after the manner of the respiratory organs of animals. MM. Laire and Montmagnon propose to take advantage of the well-known property of wood charcoal, alkaline solutions, and blood of absorbing oxygen from the surrounding air, and condensing it between their molecules, either by a physical or chemical affinity. It is proved, by experiment, that 100 measures of wood charcoal, freshly burnt, absorb 985 of oxygen, and only about 705 of nitrogen. The blood of animals and solutions of phosphate and carbonate of soda absorb rapidly, according to the amount of surface exposed to the air, about 12 per cent of oxygen, and only two per cent of nitrogen. The proposed method of using

these facts is this:—Pump out the oxygen and nitrogen from the substances used to absorb it by means of an air-pump; pass the mixture through fresh-absorbing *media in vacuo*; re-extract, and repeat the operations as often as required. In this way an oxygen is obtained very free from nitrogen, and at an extremely cheap rate. The reservoir which contains the charcoal, &c., may be compared to the lungs of animals, and the air-pump to the pulmonary apparatus of the same nature. If this process should succeed upon a commercial scale, it will be a beautiful example of the imitation of one of nature's great processes, and its adaptation to the wants of man.—*British Journal of Photography*.

Astronomical Clock for Beauvais Cathedral.—Although not exactly belonging to the subjects the pages of our paper are devoted to, we abstract from the French journal *Les Mondes*, the following:—The clock is destined to be placed within the cathedral church; it is a piece of furniture constructed according to the designs of the Rev. Father Piérart, S.J., 12 metres in height, 5 metres wide, and 2 metres deep; it contains fifty-five dial plates, and indicates eighty different things; the internal work contains 90,000 parts. The clock indicates the exact time for twenty different parts of the globe, indicates also the precise moment of the rising and setting, and meridian passage of the sun and moon at Beauvais for every day of the year, and, moreover, the rising and setting of no less than 10,000 stars for the same place; besides this, other things, as saints' days, &c. At present the clock is at Paris, and may be seen in the Palais de l'Industrie; The entire work is highly spoken of, both as work of applied science and of fine art. The clock has been made, it appears, at the desire and expense of Magyar Grignoux, Bishop of Beauvais.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Effect of Heat on the Electromotive Force of the Galvanic Battery.—M. Crova.—(*Cosmos*).—The results obtained by the researches of this author are the following:—(1) The electromotive force of the Daniell's element decreases regularly with an increase of temperature; (2) the electromotive force of a Grove's element increases with the temperature; (3) the electromotive force of an element wherein only one liquid is applied (Smee's) is independent of the variations of temperature.

Action of Light upon Chloride of Silver.—(*Les Mondes*).—When freshly-precipitated chloride of silver (best obtained by means of decomposing a soluble silver salt with chlorine water) is placed in a white glass tube about 15 inches in length, and exposed to the action of direct sunlight, it will be observed that the chloride of silver remains quite white as long as the solution of chlorine water retains its greenish yellow colour; but as soon as that colour has vanished, the chloride of silver begins to decompose under the influence of the direct rays of sunlight; the chloride gradually blackens, and after a shorter or longer duration of time, the whole quantity will have become black, especially if care be taken to shake the tube now and then, so as to expose the whole mass to the light. When the tube is afterwards placed in a dark place entirely excluded from daylight, the black colour of the chloride of silver again disappears gradually, and the chloride becomes white; this experiment can be repeated over and over again with the same tube. The bromide, and probably also the cyanide of silver, behave in the same manner; the iodide of silver blackens only after having been rendered sensitive to light by pyrogallie acid.

Action of Sunlight on Glass.—M. Graffield.—(*Cosmos*).—It is a well-known fact that, even independently from the effects of rain and wind, glass, even of good quality, is affected by sunlight. The late Dr. Faraday made some observations concerning this subject, and found that violet-coloured glass became deeper and more intensely coloured than it originally was after having been exposed to direct sunlight for eight months. M. Graffield, of Boston, U.S., who has been for more than twenty years in the wholesale glass trade, and is at the same time a good observer, has recently sent to the Photographic Society of Marseilles a series of the results of his researches and observations on this subject, in which he comes to the conclusion (which is especially important to photographers) that glass is even sensibly affected after one single day's exposure to the sun's rays, and that all glass, without exception, including that used for optical purposes, is more or less acted upon, even when made from the best materials and by most experienced workmen; greenish glass seems to become the least affected. The author has sent to Marseilles a series of photographs representing the tinge and changes produced in divers varieties and kinds of glass after exposing them to sunlight.

Adulterated Soap.—(*Les Mondes*).—It appears that, in consequence of some complaints concerning the soap supplied at the thermal establishment at Amélie les Bains, this soap was analysed. Its colour was greyish; odour very disagreeable (especially when recently cut); to the touch it was peculiarly greasy, causing a biting sensation at the same time. It was readily soluble in distilled water, producing a good lather, but the solution produced a biting pain when brought into contact with the hands. In 100 parts, the soap contained 29 of alkali and 19 of tallow; no wonder, therefore, of its effects on the skin, and complaints in consequence thereof.

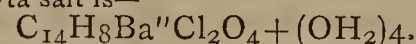
Oxyhydrogen Light.—Reduction of Earthy Metals.—The learned Abbé Moigno, while referring to this subject in *Les Mondes*, says, our readers will undoubtedly learn with pleasure that the production of oxygen in cheap manner from manganate of potassa and of pure hydrogen, by means of a hydrocarbon fuel (*combustible hydrocarboné*), on the large scale, has become a decided success; that, moreover, the reduction of the earths baryta, magnesia, and alumina to the metals barium, magnesium, and aluminium, by means of hydrogen under high pressure and a very high temperature, is successfully carried out; while, lastly, M. Caron has succeeded in obtaining, by means of great perseverance, zircon-magnesia cones, which, instead of being very breakable and only lasting for a few nights, are fit for use for any length of time.

Brittleness of Bones.—(*Les Mondes*).—Professor Hofmann, at Prague, has recently analysed bones of cattle, some of which were derived from healthy animals, others, again, from animals which during life had been affected with fracture of bones consequent upon their great brittleness; while the composition of the former was normal, that of the latter proved to be abnormal, by containing a far greater proportion of carbonates and phosphates of lime and magnesia, while, at the same time, the nitrogen contained in the organic matter of the bone was considerably less than it should be; hence the Professor advised that, as a remedy in such cases, food richer in nitrogenous substances should be administered to the cattle.

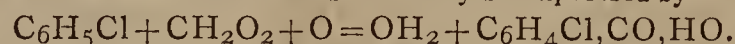
Platinising Copper, Yellow Metal, and Brass.—(*Les Mondes*).—In order to obtain the platinising fluid, add, to a moderately-concentrated solution of chloride of platinum, finely-powdered carbonate of soda until effervescence ceases, next some glucose, and afterwards just so much common salt as will cause a whitish-coloured precipitate. When it is desired to apply this mixture for platinising, the objects to be treated are placed in a vessel made of zinc and perforated with holes; the vessel is then placed, with its contents, for a few seconds into the mixture just described, which, just previous to using, should be heated to 60° C. On being removed from the zinc vessel, the objects are to be washed with water and dried in sawdust.

Researches on Materials fit for Resisting very High Temperatures.—M. Audouin.—(*Cosmos*).—While engaged with other studies on geology in the southern parts of France, the author found that between Tarascon and Antibes there exists a very valuable and extensive bed of *bauxite* (hydrate of alumina), which is occasionally applied for the manufacture of sulphate of alumina. This material has been applied, at the suggestion of Audouin, for the manufacture of crucibles and fire-bricks; and on having been tested in comparison with the best products of the kind from France, England, and Germany, it was found that even best fire-bricks might be melted in bauxite-made crucibles heated by mineral oils and a blast.

Synthesis of Paramonochlorobenzoic Acid.—(*Zeitschr. f. Chem. v. Beilstein*).—Carl Müller has instituted, in the laboratory of Dr. Carius, at Marburg University, some researches on this substance. He found that paramonochlorobenzoic acid originates when chloride of benzol, C_6H_5Cl , is oxidised by the action of moderately dilute sulphuric acid and peroxide of manganese; a number of other products are simultaneously formed—among these, chiefly formic acid. Paramonochlorobenzoic acid is a solid substance, fusible at 235° C., readily soluble in alcohol and ether, but difficultly so in water; one part of the acid requires 5288 parts of water for solution. The acid crystallises both by sublimation and from its alcoholic solution; the composition of its baryta salt is—



Its formation from chloride of benzol may be expressed by—



On the Solubility of Difficultly-Soluble Compounds in Aqueous Solutions of Sugar.—(*Zeitschr. f. Chem. v. Beilstein*).—Dr. Jacobsthal has instituted a series of experiments on this subject, in order to ascertain the presence of various salts and their bearing upon the manufacture of beet-root sugar. The author experimented with the sulphate, carbonate, oxalate, citrate, and basic phosphate of lime, and the carbonate of magnesia; quantities of these salts in excess were placed in solutions of pure sugar in distilled water, containing respectively 5, 10, 15, 20, and 30 per cent of sugar. The salts were placed in flasks, heated for awhile on a water-bath, and left standing for from four to five days, care being taken to replace any water which might have evaporated, and also to shake the flasks daily for some time; the solutions were then filtered, and in the clear filtrate the quantity of salt dissolved was determined. The results obtained are exhibited in a tabular form, which represents—(1) the quantity of the various salts dissolved in 1000 c.c. of the different sugar solutions; (2) the quantity of the salts which would have dissolved in the water present in the various sugar solutions, deducting the quantity of water required to keep the sugar respectively therein contained dissolved. It appears that the more a sugar solution is concentrated, the less it is capable of dissolving the salts experimented upon; the carbonate of magnesia is the only salt which makes an exception upon this rule; the results agree with some observations made by Cunze, who witnessed the separation of oxalate of lime from a sugar solution on becoming concentrated from 5 to 30 per cent.

Adulteration of Sulphuric Acid.—(*Rev. Hebd. de Chim.*)—It appears that some Continental makers of this acid are in the habit of adding to ordinary chamber acid a sufficient quantity of some cheap acid sulphate, so as to bring the sulphuric acid, as far as hydrometrical tests are concerned, up to the desired degree of density. M. Fleischer, having cause to complain about the bad quality of indigo-carmin prepared with a certain sample of sulphuric acid, was induced to evaporate some of the acid, and on doing so discovered the formation of crystals of sulphate of soda. This kind of adulteration, however readily detected, might cause in many dye and madder and garancine works very serious loss and great inconvenience, and is a gross fraud; the inducement is the saving of the cost of evaporation and apparatus connected therewith.

On the Constitution of Glucina.—(*Zeitschr. f. Chem. v. Beilstein.*)—Dr. G. Klatzo has written, at Dorpat University, an essay on this subject, and conducted a series of experiments with oxide of glucinum, and prepared a large number of salts and double salts of this base. He has made several analyses of sulphate of glucina, and calculated from the results thus obtained the percentage of oxygen contained in the glucina at 63.425 per cent, the atomic weight of BeO at 25.227, and the atomic weight of Be at 9.227. As general results of his researches, the author states—1st, that glucina is in every respect a base similar to magnesia, which it can displace without change of crystalline form and quantity of water of crystallisation; 2nd, the sulphates of glucina, heated to 150° C., still retain one atom of water, which, as is equally the case with magnesia salts, can be displaced by sulphate of potassa; 3rd, like magnesia and oxide of zinc, glucina crystallises from its solution in excess of water saturated with carbonic acid, and yields a neutral crystalline carbonate, capable of forming, with the carbonates of the alkalies, perfectly crystallising double salts.

NOTES ON LECTURE EXPERIMENTS.

Colouring Carbonic Acid.—Carbonic acid may be coloured brown by nitrogen peroxide. This gas is easily obtained by heating lead nitrate in a test-tube, and by means of a bent tube, conducting the brown fumes into the vessel containing the carbonic acid. Bromine vapour may be used, but the smell is very disagreeable. A simple method of rendering carbonic acid visible is that described by Priestley—"Experiments and Observations on Different Kinds of Air," 3rd edition, 1781, pp. 25-6—viz., by extinguishing lighted candles, paper, &c., in the gas, when the smoke clings to it, rendering it visible. If gunpowder be fired in a large vessel filled with carbonic acid, the smoke, as stated by Priestley, scarcely escapes from the vessel; and, on tilting the vessel thus charged with carbonic acid and smoke, the pouring out of the gas is rendered distinctly visible even from long distances, forming, as a friend of mine used to say, a "gascade."—C. J. WOODWARD, Midland Institute, May 3rd, 1869.

Hydrogen Bottle.—Thin sheet-lead is worked into the shape of a round bottle, with a wide neck to hold a cork; a gas-cock in the dome or neck of the bottle. Before joining the bottom, a perforated tray of lead is inserted, about 2 inches up into the bottle. A short bit of lead pipe ($\frac{1}{2}$ inch) opens into the bottle below. The first idea proposed a cylindrical chamber, fastened to the bottle towards the top, and communicating, by pipe, with the opening below. Into this chamber the liquid is forced by the gas. The suggestion of this year is simple—To put the bottle into any vessel with acid solution. A large quantity of granulated zinc may be put on the tray. This, and the bottle being of lead, galvanic action promotes the evolution of gas, which forces out the liquid, &c., as in the hydrogen lamp. I used the bottle in the simple form this year, and found it all that could be desired. Even the cleaning is easily done. The oxide and sulphate fall through the tray to the bottom and wash out.—RICHARD MCNEVIN; EDWARD CANNON (1862). CHRISTOPHER DUNN (1869), Clongowes.

PATENTS.

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

368. H. A. Dufrené, Rue de la Fidélité, Paris, "Improvements in the manufacture of ice and of the agents employed therein, and in the apparatus connected therewith."—A communication from C. Tellier, Paris.—Petition recorded February 6, 1869.

1083. J. Dewar, M.D., Kirkcaldy, Fifeshire, "Improvements in treating certain substances for food and for manure."—April 9, 1869.

1103. E. C. C. Stanford, Glasgow, N.B., "Improvements in applying, treating, and utilising materials for deodorising solid, liquid, and gaseous matters."—April 10, 1869.

1151. W. Wright, Mostyn, Flint, "Improvements in treating ores to obtain copper and other metals therefrom."—April 14, 1869.

1197. H. Aitken, Falkirk, N.B., "Improvements in treating iron ores or iron stones."—April 19, 1869.

1203. A. Brady, Stratford, Essex, "Producing pure iron direct from crude iron ore."—A communication from E. Brady, Philadelphia, Penn., U.S.A.—April 20, 1869.

1224. M. Henry, Fleet Street, London, "An improved mode of obtaining pyro-phosphate of lime."—A communication from E. Deligny, Boulevard Saint Martin, Paris.

1227. C. D. Abel, Southampton Buildings, Chancery Lane, "A new or improved method of, and materials for, the preparation of mural paintings."—A communication from P. Oury and P. Cousin, Rue de Trois Freres, Paris.—April 21, 1869.

1244. A. Borgnet, Swansea, South Wales, "Improvements in the manufacture of paint."—April 22, 1869.

INVENTIONS PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

1290. S. Oakman, Boston, Mass. U.S.A., "Improvements in the construction of smelting and other furnaces."—Petition recorded April 26, 1869.

NOTICES TO PROCEED.

3837. G. Hadfield, Lancaster, "Improvements in the manufacture of varnish."—Petition recorded December 17, 1868.

3830. C. Liebermann and C. Grache, Berlin, Prussia, "Improvements in preparing colouring matters."—December 18, 1868.

3870. P. Spence, Newton Heath, near Manchester, "Improvements in the manufacture of alum and aluminous salts."—December 19, 1868.

3893. W. E. Gedge, Wellington Street, Strand, Middlesex, "A novel bituminous composition."—A communication from F. Labat and J. Meric, Boulevard Bonne-Nouvelle, Paris.—December 21, 1868.

375. C. D. J. Seitz, Bury, Lancashire, "Improvements in the construction of furnaces and pans for the recovery of the soda from the waste lyes resulting from the boiling of esparto grass, straw, or other fibrous substances, in the working and incinerating of the residue resulting from evaporation."—February 6, 1869.

600. J. Townsends, Glasgow, N.B., "Improvements in extracting and in refining oils and other products from mineral and other materials containing carbon and hydrogen, and in apparatus therefor."—February 26, 1869.

969. G. Wells, Westminster, "Improvements in separating copper and bismuth from ores containing metals either separately or combined with other metals."—A communication from T. Y. Cotter and C. L. Dubois, Adelaide, Australia.—March 31, 1869.

NOTES AND QUERIES.

Chemical Infinity.—*Appleton's Journal* contains in its first number a calculation by Berthelot, the eminent French chemist, of the number of combinations which may be made of acids with certain alcohols. He says, if you give each compound thus possible a name, and allow a line for each name, and then print 100 lines on a page, and make volumes of 1000 pages, and place a million volumes in a library, you would want 14,000 libraries to complete your catalogue.

The Gulf Stream.—Captain Maury considers the Gulf Stream equal to a stream 32 miles broad and 1200 feet deep, flowing at a rate of 5 knots (38,415 feet) an hour. This gives 6,166,700,000,000 cubic feet per hour as the quantity of water conveyed by this stream. Sir John Herschel's estimation is still greater; he considers it equal to a stream 30 miles broad and 2200 feet deep, flowing at the rate of 4 miles an hour; this makes the quantity 7,359,900,000,000 cubic feet per hour. Sir John estimates the temperature of the water at 86° F.—*Engineer*.

Carbonic Acid.—Mr. Kernan evidently forgets that common washing soda contains—(1) more than half its weight of water of crystallisation, and (2), unless purposely purified, is contaminated with some undecomposed chloride of sodium and sulphate of soda, containing, moreover, caustic soda; the substance being, moreover, soluble in water, is not so well adapted also on economical grounds for the production of carbonic acid gas as is white marble, or any other lime-stone, which, weight for weight, will yield more gas than the common washing soda. Of course it may be used, but it has no advantage.—Dr. A.

An Excellent Indelible Ink may be prepared by rubbing up 1 drachm of aniline black with a mixture of 60 drops of concentrated hydrochloric acid and 1½ ounces of alcohol. The resulting deep blue liquid is then to be diluted with a hot solution of 1½ drachms of gum-arabic in 6 ounces of water. This ink does not corrode a steel pen, and is effected neither by concentrated mineral acids nor by strong lye. If the aniline black solution be diluted with 1½ ounces of shellac, dissolved in 6 ounces of alcohol, instead of with the gum-water, an aniline black is obtained, which, after being applied to wood, brass, or leather, is remarkable for its extraordinary deep black colour.—*American Artisan*.

Supply of Water for Domestic Purposes.—From a brief report of the proceedings of the Municipal Council of Nismes, France, we copy the following figures, indicating the quantity of potable water supplied daily in litres to the under-mentioned places for each head of inhabitants:—

	litres.
Ancient Rome	1500
Rome of present day	900
New York	360
Carcassonne	400
Besançon	270
Dyon	270
Bordeaux	170
Paris, at present	125
„ in 1871	250
London	95
Lyons	85
Brussels	80
Genève	74
Nismes	200

Action of Heat on Peroxide Salts of Iron.—The observation of M. Debray, reported in your last issue, on the action of heat upon the peroxide salts of iron, explains a matter that I have almost invariably noticed for several years past, in testing commercial sulphate of soda, or salt-cake. As manufactured on the large scale, this substance always contains a small amount (from 0.25 to 0.5 per cent) of the sulphate of peroxide of iron, and, when dissolved in cold water, forms a colourless solution, even when concentrated. If hot water be used, or if the cold solution be gradually heated, it immediately becomes quite brown-coloured, and particles of hydrated peroxide of iron are observable, the static equilibrium having been in this case disturbed by the sulphate of soda present.—BRISTOWE.

"How to Prevent the Spread of Scarlet Fever."—As far as it has been possible to ascertain, the miasma of scarlet fever, *febris scarlatina maligna*, is a fixed contagium, not volatile, nor to be met with at a distance from the patient who, while suffering from the disease, produces the peculiar miasma, about the real nature of which, be it a germ, or something else, nothing is precisely known; it is, however, a fact that keeping disinfectants in the locality where a patient suffering from the disease is confined, is beneficial as a prophylactic for those attending upon him. Green copperas, sulphate of protoxide of iron, would not be so fit to use in this special case as sulphurous acid, hypochlorite of lime, or carbolic acid. Green copperas may disinfect drains and cess-pits, but would be of little avail in this particular case, the less so as the evident proof has not been given that scarlatina is propagated in the way spoken of by "Sanitas." This discussion should rest here, as it is not one to which the columns of this paper are open, being a purely medical subject.

MEETINGS FOR THE WEEK.

- TUESDAY, 11th.**—Royal Institution, 3. Professor Grant, "On Stellar Astronomy."
— Photographic, 8.
- WEDNESDAY, 12th.**—Society of Arts, 8.
— Geological, 8.
— Microscopical, 8.
- THURSDAY, 13th.**—Royal Institution, 3. Professor Tyndall, "On Light."
— London Institution, 6.
— Royal Society, 8.30.
— Zoological, 8.30.
— Royal Society Club, 6.
- FRIDAY, 14th.**—Royal Institution, 8. Mr. Perkin, "On the Newest Artificial Colouring Matters."
- SATURDAY, 15th.**—Royal Institution, 3. Prof. Seeley, "On Roman History."

TO CORRESPONDENTS.

* * We shall feel indebted to correspondents who will forward us Reports of Local Meetings of Societies, Chemical Appointments, and any other subjects interesting to the chemical world. We regret that, owing to the increasing popularity and circulation of the CHEMICAL NEWS, and consequent pressure on our space, we are often obliged to delay the publication of long papers. To those correspondents who wish to favour our readers with Notes of New Discoveries, Descriptions of Apparatus, or Answers to Questions, we would especially recommend our Notes and Queries columns.

ERRATUM.—Page 204, column 1, 6th line from top, for (2) 951 read (2) 634, and for (3) 1032 read (3) 688.

W.—The treatise mentioned by you on water analysis is excellent; you can, if so inclined, purchase from Messrs. Griffin all the apparatus and test liquids, ready made, adapted for use according to the directions of this book. As to sewage, there does not exist any special treatise on the analyses thereof, but in Fresenius's and Noad's works on "Quantitative Analysis" you will find every information you may require to enable you to analyse what you desire. Your letter will appear next week.

A Subscriber since January.—Mr. Little's letter "On the Estimation of Phosphates," in No. 434 of the CHEMICAL NEWS, will probably give the information you require.

W. J. Morgan.—You will find a good chapter on the use of the spectroscope in the last edition of Fresenius's "Quantitative Analysis." A book on the subject will shortly be published by Macmillan.

Tincture.—If you intend to sell it as a proprietary medicine it will certainly require the medicine stamp. By sending particulars to the Board of Inland Revenue, Somerset House, you will receive full information on the subject.

E. K.—The description of the apparatus is received, with thanks; we are always glad to have notes of novelties or improved apparatus. The yellow, red, and green lines shown by sodium, lithium, and thallium in the spectrum microscope are true lines, not bands. A band is not generally sharp at the edges, and is wider than the image of the slit. Your difficulty is probably more apparent than real, still we should like to see Father Secchi's answer to your question. The description of the battery was too complicated, and required too many cuts to enable it to be given in our pages; it was, however, of use to one or two correspondents. Hofmann's report on the aniline colours at the Paris Exhibition is given as a supplement to the English edition of Reimann's "Aniline." The book can be obtained at our office.

E. C. C. S.—The paper as last sent will be inserted next week; the second paper will follow.

Paper's questions cannot be answered without going into details, which must be fully discussed. A letter is waiting for him at our office.

Communications have been received from Dr. H. Lawson; E. Kernan; J. Emerson Reynolds; R. Weaver; H. Hudson; W. L. Spiers; F. M. Jennings; Messrs. Townsend and Adams; Hugh Munro; Jones, Bros., and Co.; R. Spice; G. H. Ogston; E. W. Streeter; L. Demuth and Co.; J. Simpson; S. and E. Collier; Morgan and Davies; J. Mosley (with enclosure); C. Tomlinson, F.R.S.; G. F. Rodwell; Street, Bros.; J. Browning; A. Norman Tate (with enclosure); J. Denman (with enclosure); J. Bagueley; A. B. Fleming and Co.; Dr. T. Wood; J. Coupland (with enclosure); S. E. Phillips (with enclosure); P. Squire (with enclosure); Longmans and Co.; W. A. Murray; H. Stephenson; R. Mallet, F.R.S.; H. Rey; Dr. Röhrig; Dr. Goedicke; E. C. C. Stanford (with enclosure); P. Finnegan; G. Preece; H. Crossley; and F. Ritchie and Sons (with enclosure).

BOOKS RECEIVED.

Laboratory Teaching; or, Progressive Exercises in Practical Chemistry. By Prof. C. L. Bloxam. London: Churchill and Sons.
Pure Wine, and how to Know it. By J. L. Denman.

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THE CHEMICAL NEWS.

Vol. XIX. No. 493.

ON A NEW METHOD OF ESTIMATING THE REDUCED PHOSPHATES OF LIME, MAGNESIA, IRON, AND ALUMINA, IN SUPERPHOSPHATES OR MANURES.

By J. A. CHESSHIRE.

ATTENTION having been called this season to what is termed the going back, or the reduction, of the soluble phosphates into insoluble phosphates in superphosphates, as an analytical chemist at a manure works in the mid-land counties (Bradburn and Co., Wednesfield, near Wolverhampton), I have been required to estimate the reduced phosphates so formed. The plan now in use—viz., boiling with citric acid—is, I have found, not to be relied upon, as I have partially dissolved ground coprolite in this acid. The way that I am in the habit of doing is this.

Take about $1\frac{1}{2}$ grammes of superphosphate, extract the soluble part with cold water, and, afterwards, with boiling water; wash the insoluble residue on the filter into a beaker, boil for about half an hour with oxalate of ammonia and about two drops of oxalic acid, so as to have a slight acid reaction; this I do in order to keep the phosphate of magnesia in solution. Then filter; the filtrate contains the phosphates of lime and magnesia, and, perhaps, a little phosphate of iron and alumina. To the filtrate add tartaric acid, ammonia, and the magnesia mixture, weigh the precipitate, and estimate the phosphoric acid as $\text{Ca}_3(\text{PO}_4)_2$; the insoluble residue on the filter, from the reduced lime and magnesia, wash into a beaker, boil for about one hour with sulphide of ammonium and a few drops of ammonia, filter, &c.; to the filtrate add the magnesia mixture, and calculate the results in the same manner as the reduced phosphates of lime and magnesia.

I may add, that the reduced phosphates so formed are quite equal, in money value, to the soluble phosphates.

ON THE SOURCE OF FREE HYDROCHLORIC ACID IN THE GASTRIC JUICE.*

By Professor E. N. HORSFORD, Cambridge, U.S.A.

FOLLOWING up the researches of Prout, C. Smidt, Lassaigne, Tiedemann and Gmelin, Berzelius, Blondlot, Claude Bernard, Schwann, and others, the author endeavours to determine how free hydrochloric acid can be secreted from the blood, which is an alkaline fluid. He assumes that in healthy digestion, as a consequence of increased flow of blood to the gastric mucous membrane, and of the normal elasticity of the walls of the capillaries, there exists in the membrane a condition which is the equivalent of engorgement. Under the pressure which attends this condition, the corpuscles in contact with the walls of the capillaries would discharge a portion of their acid contents, which, with the adjacent plasma, would pass through the walls of the capillaries. This mixture would contain acid phosphates and chlorides.

By pressure and osmosis, a portion of this fluid will pass through the walls of the gastric tubes; and, to determine whether the fluid that goes through contains free hydro-

chloric acid, the author employed an acid phosphate of lime of specific gravity 1.117, of a constitution of $3(\text{CaOPO}_5) + 2\text{PO}_5$, with an amount of phosphate of peroxide of iron present as one to twenty-eight of the acid phosphate of lime. The various other solutions employed were the ordinary laboratory reagents.

On adding ammonia in small quantities to the solution of acid phosphate, with alternate agitation, it required several repetitions before the peroxide with its phosphoric acid became a permanent precipitate, and still several more before the precipitate of phosphate of lime became permanent.

The experiments were made with parchment-paper, prepared from German and Swedish filter-paper, as well as with goldbeater's skin (animal membrane).

He employed acid phosphate of the formula above, with (each by itself) chloride of sodium, chloride of ammonium, chloride of potassium, chloride of calcium, and chloride of magnesium.

The author also experimented with acetate of potassa and acid phosphate of lime.

With all these there was obtained the same kind of evidence of increased acidity on one side, and of increased alkalinity on the other, to wit, the powder thrown down from the mixture of acid phosphate and chloride. What successive additions of ammonia had been required to effect had been accomplished by dialysis.

The same effect took place from a mixture of acid phosphate of soda and chloride of calcium.

It follows from the above, if these experiments fairly represent the case, and from the known composition of the blood, its condition in the walls of the stomach, and the structure of the gastric tubules, that free or uncombined hydrochloric acid must find its way into the bottoms of the gastric tubules, and thence into the cavity of the stomach.

The secretion of hydrochloric acid is mixed with acid phosphates and alkaline chlorides.

The author therefore states that, whatever other peculiarities the blood corpuscles may possess, they have the requisites for furnishing acid phosphates in solution under pressure, such as must attend engorgement of the capillaries in the walls of the stomach; that, in all probability, as the acid fluid enters the gastric tubules, they are surrounded by a mixture of hydrochloric acid, acid salts, neutral salts, and albumenoid bodies. Dialysis must be repeated, and a stronger acid solution pass into these sacs. The sacs, swelling by endosmosis, and corroded by the acid, must at length burst, and the liquid contents, together with the disintegrated and partially-digested membrane of the sacs, pass out into the stomach, to constitute the gastric juice; the free hydrochloric acid, acid phosphates and chlorides, and the albumenoid bodies and disintegrated tissue (*the pepsine?*) to act in the liquefaction of food.

ON A CERTAIN EXCRETION OF CARBONIC ACID BY LIVING PLANTS.*

By J. BROUGHTON, B.Sc., F.C.S.,

Chemist to the Cinchona Plantations of the Madras Government.

WHILE the author was engaged in some experimental determinations of the changes that take place in the composition of the Cinchona barks after being taken from the tree, he noticed a somewhat singular circumstance, which induced him to institute a series of experiments, by which he discovered that the various parts of living plants excrete carbonic acid, not only in their normal condition, but after they have been deprived for days together of all access of oxygen. The experiments were mostly made on cut portions of the plants, but experiments were also made for control on plants as they actually grow. The

* Abstract of a paper read before the Royal Society, April 15th, 1869.

* Abstract of a paper read before the Royal Society, April 28th, 1869.

deprivation of oxygen was effected sometimes by Sprengel's air pump, sometimes by substituting for air an atmosphere of hydrogen or nitrogen, while comparative experiments were made on plants supplied with air that had been freed from carbonic acid. The main conclusions to which he was led are those enunciated by the author:—

1st. That nearly all parts of growing plants evolve carbonic acid in considerable quantities, quite independently of direct oxidation.

2nd. That this evolution is connected with the life of the plant.

3rd. That it is due to two causes, namely, to previous oxidation, resulting after a lapse of time in the production of carbonic acid, and to the separation of carbonic acid from the proximate principles of the plant while undergoing the chemical changes incident to plant-growth.

THE

ELLERSHAUSEN PROCESS OF REFINING IRON.

THE recent invention of Mr. Ellershausen, which is now regularly in use in Pittsburg, Pa., and is being rapidly introduced all over the country, has greatly advanced the solution of the problem of cheap iron.

The process consists in the conversion of crude cast-iron, as it runs from the smelting furnace, into wrought-iron, by the simple admixture of pulverised iron ore. It is carried out at the works of Messrs. Shoenberger, at Pittsburg, in the following manner:—On the casting floor of the smelting furnace, a cast-iron turn-table, about 18 feet diameter, is revolved on rollers by a small steam-engine. Upon the outside edge of the table stand a row of cast-iron partitions, forming boxes, say, 20 inches wide and 10 inches high, open at the top. Just above the circle of boxes stands a stationary, wide-mouthed spout, terminating in the tap-hole of the furnace. When the furnace is tapped the liquid iron runs down this spout, and falls out of it in a thin stream into the boxes as they slowly revolve under it, depositing in each a film of iron say one-eighth of an inch thick. But before the fall of melted iron reaches the boxes it is intercepted, or rather crossed, at right angles, by a thin fall of pulverised iron ore, which also runs out of a wide spout from a reservoir above. These two streams or falls are of about equal volume, say one-quarter of an inch deep and 20 inches wide. A workman, with a bar in the tap-hole, regulates the stream of iron, and the iron spout from which the liquid metal falls into the boxes is removable; other spouts, previously coated with loam and dried, being attached to a common revolving frame, so as to be ready for use when the loam covering of the first becomes cracked or removed.

The thin layers of iron and ore soon chill and solidify, so that by taking away the outer partition of the boxes (which form the rim of the turn-table) they may be removed in cakes of the size of the boxes and weighing about 200 pounds each. Four of these cakes or blooms are put into a reverberatory puddling or heating furnace, and raised to a bright yellow heat. They will not melt at this heat, but become softened so as to be easily broken up with a bar. The four blooms are formed in the furnace by the "rabble" of the workmen, as in ordinary puddling operations, into eight balls. The balls are brought out one after another, squeezed in the ordinary "squeezers" to expel the cinder and superfluous ore, and then rolled into wrought-iron bars, which are now ready for market, or for further reduction into smaller finished forms.

The chemistry of the operation is as follows:—The crude cast-iron contains, say, 5 per cent of carbon, and 2 per cent of silicon, and more or less sulphur, phosphorus, and other impurities. In the Bessemer process the oxygen of the air, blown into the liquid iron, combines with this carbon and these other impurities, and not only removes them but leaves the pure iron in a liquid state,

from which it can be cast into homogeneous masses of any size. In the puddling process, the oxygen of the air and of the ore or other "fettling" put into the furnace with the iron combines with and eliminates the impurities, which are afterwards squeezed out of the pasty mass by the squeezers and rolls. This process is long and comparatively expensive, because the mixture of oxygen or oxygen-bearing substances is not made intimate with the iron except by long stirring, which is not only skilful but exhausting work.

In the Ellershausen process the oxygen of the ore or oxide of iron (manganic oxide is preferred) combines with the carbon and impurities, eliminating them as in the puddling process, and the iron of the ore increases the product. The chemical combination of the ore and the liquid crude iron appears to take place partly at the time of their contact when falling and lying upon the turn-table, and partly where the re-heating occurs in the furnace. It seems impossible that a reaction which is so violent in the Bessemer process, and so prolonged in puddling, should take place so quickly and quietly in the new process, but the fact that the cakes of iron and ore do not melt by subsequent heating, as cast-iron would, proves that its nature is changed by the first contact of the ore. The removal of sulphur and of phosphorus also seems more thorough than in the other processes. Analyses at different stages of the operation will throw more light on this question.

The remarkable feature of the Ellershausen process is that absolutely no skill is required to carry it out. The proportion of ore mixed is intended to be about 30 per cent, but if too much is added, it is readily squeezed out with the slag, and seems to do no harm. The subsequent heating occupies about half an hour. "Puddle-bar," the product obtained from the first rolling of the product of the puddling furnace, is never marketable or finished iron. It is usually very ragged and unsound, and requires subsequent piling, re-heating, and re-rolling, to expel the impurities, and to give it soundness and solidity. The new process appears to produce merchantable iron at the first rolling, and at Pittsburg, from a very inferior pig-iron made of one-half sulphurous Canada ores, and one-quarter Lake Superior and one-quarter Iron Mountain ores.

The thoroughness and rapidity of the purification by this process evidently depend on the intimacy of the mixture of iron and ore. This intimate mixture is also the essence of the Bessemer process. In fact, to Mr. Bessemer's original apprehension of this idea of intimate mechanical mixture the greatest modern improvements in the iron manufacture are due.

The Ellershausen process is said to decrease the cost of wrought-iron from 10 dollars to 20 or 30 dollars per ton, according to the materials used and the form of the product required. That it is a success is amply proved by regular working at Pittsburg and many experiments elsewhere.—*American Artisan.*

DR. LETHEBY,

ON THE

METHODS OF WATER-ANALYSIS AND ON SEWAGE CONTAMINATION.

A FEW weeks ago Dr. Letheby read a very important paper to the Metropolitan Association of Medical Officers of Health, entitled "On the Methods of Estimating Nitrogenous Matters in Potable Waters, and on the Value of the Expression 'Previous Sewage Contamination,' as used by the Registrar-General in his Monthly Reports of the Metropolitan Waters." The discussion which followed it was very animated, and was so long that an adjournment for a fortnight was found necessary. In this interesting paper, Dr. Letheby attacked with great warmth the methods of analysis employed by Dr. Frank-

land, the deductions which the latter chemist thinks himself justified in making from the results of his analysis, and in particular the well-known calculation of "previous sewage contamination" from the nitrogen found as nitrates, nitrites, and ammonia in the water. He described the methods in which he himself places reliance—methods which need not be recapitulated here because they are familiar to almost all chemists—and in contrast with them recited a formidable list of the difficulties and errors to which, he asserted, Frankland and Armstrong's methods were liable. This part of the subject, important though it be to chemists, we do not propose to discuss in any detail at the present time, reserving it, if need be, for a separate consideration hereafter. The combustion process, by which Dr. Frankland estimates the organic carbon and nitrogen of a water, is, to judge from the trial experiments, very greatly more accurate than any that has hitherto been suggested for the determination of organic matter. Both the absolute and percentage errors observed in the trial experiments were, indeed, marvellously small, considering the extraordinary difficulties to be encountered. Dr. Letheby appears to rely mainly upon the permanganate test, and calculates the amount of organic matter in the water by multiplying the oxygen-indication by eight. This calculation is founded on a comparison between the indications of the test and those of the old incineration method; but as the latter has long been known to be worthless, and as Dr. Letheby himself has abandoned its use, it is difficult to see how the calculation can give even an approximation to correctness. Every one of our readers is, moreover, aware that the oxidising power of the permanganate varies extremely in different cases; that of nine kinds of organic matter examined by Frankland and Armstrong, one—viz., oxalic acid—was completely oxidised by it, even in six hours; that urea, hippuric acid, and creatin were scarcely oxidised at all, while the mineral, sodic nitrite, was oxidised instantaneously.

These considerations are, however, somewhat irrelevant upon the present occasion, for Dr. Letheby does not seriously impugn the accuracy of the method by which Frankland and Armstrong effected the determination of the nitrogen present as nitrates and nitrites, and agrees with the latter chemists in employing the Nessler test for the determination of ammonia. It is from these compounds that the previous sewage contamination is calculated, and it is to this calculation that the criticism of Dr. Letheby is mainly directed. The ammonia present in potable waters is generally a small quantity, and we may therefore assume, for the purpose of the present discussion, that the previous sewage contamination is entirely deduced from the nitrates and nitrites of the water. Dr. Letheby does, indeed, impugn the accuracy of the correction made by Dr. Frankland for the nitrogen introduced by rain; but this makes little real difference, for even if the estimate of Lawes, Gilbert, and Way be adopted, and the river be assumed to contain the whole quantity of combined nitrogen found by those chemists in the rain of Rothamstead, without a grain having been removed by vegetation, the deduction would only be equal to 985 parts in 100,000 of previous sewage contamination, instead of 320, a difference equal to less than one-fifth of the amount frequently attributed to some of the London waters in the Registrar-General's returns.

Divested in this manner of collateral issues, the arguments of Dr. Letheby may be reduced to a few simple propositions. He maintains, in the first place, that the nitrates and nitrites of potable waters are not due solely to the oxidation of animal matters, but are frequently derived from other sources, and that therefore it is fallacious to use them as a measure of previous animal contamination. Under any circumstances, moreover, they could not be an accurate measure, because the process of vegetation is constantly removing them from waters exposed to its action, and it consequently happens that waters known to have received sewage contamination are sometimes found to contain scarcely any oxidised nitrogen,

while others which, it is alleged, cannot have received any such contaminations contain much. A good illustration of this apparent anomaly was quoted by Dr. Letheby. In the months of July, August, and September, 1868, the water supplied by the Kent Company, and derived by them from deep chalk wells, was described by the Registrar-General as exhibiting a previous sewage contamination of 3660, 3660, and 3530 parts in 100,000; while that of the East London Company, derived from the sewage-contaminated Lea, was returned for the same months as 0, 0, and 20.

It is furthermore urged by Dr. Letheby that it is unfair to describe by a name calculated to produce disgust and alarm, a contamination which, whatever its source, has been oxidised and rendered innocuous in the water. Sewage diluted with twenty parts of water is, he asserts, entirely destroyed in the course of a run of ten or twelve miles down a river, and it is therefore impossible for mischief to arise from the drinking of such water.

To these various hostile criticisms, cogent replies have been produced. Dr. Frankland argues upon the first point that, after the most diligent search, he has failed to discover the slightest evidence of the formation of nitrates from vegetable matters. Whenever nitrates are found in England or abroad, they can be traced generally with the utmost ease, to animal sources, and whenever such sources are absent, nitrates are absent too, although considerable quantities of combined nitrogen may be present. It would be a wonderful thing if the water of the chalk wells did not frequently contain nitrates, considering that it is derived by percolation from the sewage and manure-stained soil above. In the case of the chalk water supplied to London, the probability of direct sewage contamination is peculiarly great, for the great fault in the chalk, from which the Kent Company on one side of the river and the South Essex Company on the other, derives so large a supply of water, passes directly under the foulest part of the Thames. Dr. Frankland admits most fully that the calculation of sewage contamination is only an approximate one. In proportion as the nitrates have been removed by vegetation in streams or reservoirs, the calculation will, of course, be too low. All that he pretends to do is to show the *minimum* contamination which can have occurred, and he points out that injustice cannot be done to the water companies because he can never exaggerate, and very frequently under-states, the previous pollution of their water. It is of course true that animal contaminations of all kinds have to be reckoned in terms of London sewage. The phrase to which Dr. Letheby so much objects is by no means intended to signify that the contamination has in all cases been the actual sewage of towns. All such contaminations are objectionable in the highest degree, and there can surely be no harm in referring them to so suitable a standard as the one selected. It is employed for the comparison of different animal contaminations, just as physiologists compare different kinds of food by their *starch-equivalent*, without intending to assert that all kinds of food consist of starch; and it must not be forgotten that as applied to the greater part of the water supplied to London and other towns, the phrase simply states an indubitable fact.

Finally, we may observe that the self-purifying power of running water is doubted by no one, least of all by Dr. Frankland, who founds his calculation of previous sewage upon his study of it. But the absolute statement made by Dr. Letheby in regard to it—the sharp line which he draws to fix the complete purification of the water—is liable to considerable doubt. Dr. Frankland, Sir Benjamin Brodie, and many other chemists believe the process to be much less uniform and rapid than it has generally been supposed to be, and that, under certain circumstances, it is even almost inoperative; but if their views were entirely erroneous, it would be none the less incumbent upon Dr. Letheby to prove his statement. We know as an absolute fact that tons upon tons

of human excrement are thrown into the waters of the Thames and sea before we drink them, and we have a right to look for absolute demonstration of the complete destruction of all this filth; and not only of the filth itself—of the lifeless organic matter;—we must also be convinced that it is impossible, at all times and under all circumstances, for living matter—the low forms of life and their germs with which the processes of disease and putrefaction appear to be so closely connected—to retain their vitality under the conditions assigned by Dr. Letheby, before we can be content to accept his statement, or can learn to look with indifference upon previous sewage contamination.

It is, we trust, no discourtesy to say that the chemical methods heretofore employed appear inadequate for such a proof. The noxious matters of a water are probably beyond the reach of the test tube and the balance. They belong, in all probability, to that inscrutable class in which the virus of small-pox and cattle plague must be reckoned. That they would resist the oxidising action of the water longer than mere chemical compounds, can hardly be doubted, and, indeed, it has yet to be demonstrated that the dissolved oxygen of the water has any greater destroying effect upon them than it has upon the fishes which inhabit the same streams.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

May 6th, 1869.

Dr. A. W. WILLIAMSON, F.R.S., President, in the Chair.

THE minutes of the previous meeting were read and confirmed.

THE PRESIDENT then read a petition, to be presented to both houses of Parliament, of which the following is a draft:—

“The Humble Petition of the President and Council of the Chemical Society,

“Sheweth,—That the Chemical Society was incorporated by Royal Charter for the general advancement of Chemical Science as intimately connected with the prosperity of the manufactures of the United Kingdom. That in the opinion of your petitioners, the future intellectual position of Great Britain, and her success as a manufacturing nation, are in a great measure dependent on the scientific education of her people. That the Society of Arts, in their report on technical education, assert that the only effectual systematic training for technical pursuits consists of two steps—first, a thorough study of several branches of science, including chemistry; secondly, professional pupillage. That at the present time the study of natural science is altogether neglected in a large number of our secondary schools, while in the remainder it occupies only a subordinate position, both in respect of the time allotted to it and of the credit to be gained by proficiency in it. That the neglect of the study of natural science is in great part due to the influence exercised by the endowed schools, which, by their number, their antiquity, and the large funds at their disposal, determine the course of studies in other schools, their own course of education representing the requirements of a past rather than of the present age. That the necessity for inquiry into the teaching in endowed grammar schools has already been recognised by the appointment by Her Majesty of three commissions to report on this class of schools in England and Scotland. That the Schools’ Inquiry Commission have, in their report, pointed out various practicable means for the promotion and extension of the study of physical science in schools. Your petitioners, therefore, humbly

pray your honourable house to enact such laws as may procure for Chemistry, and other branches of natural science, as important a position among endowed school studies as that now occupied by Latin and Greek.—And your petitioners will, &c.”

The following certificates were read:—

For the first time—Wm. G. Valentin, assistant in the Royal College of Chemistry, 126, Lancaster Road, Notting Hill; Thomas Gillham Hewlett, Surgeon, Bombay Army, Health Officer, City of Bombay, Bombay; Captain A. Noble, Engineer, Elswick Ordnance Works, Newcastle; H. Stillington Grey Stephenson, B.A. Oxford, Sympsham Rectory, Weston-super-Mare.

For the third time—E. Meusel, University College; A. W. Reinold, Merton College, Oxford; J. M. Muir, Shortland, Thames Gold Field, New Zealand.

The last-named gentlemen were then balloted for and duly elected.

MR. J. LOWTHIAN BELL then delivered a lecture “*On the Chemistry of the Blast Furnace*,” of which the following is a condensed abstract:—

There are few chemical processes requiring for their proper operation greater nicety, or where perfect success is contained within narrower limits than the smelting of iron.

The ends sought to be accomplished in the blast furnace are the deoxidation of the peroxide of iron, which is the usual form of combination in which the metal is delivered to the smelter, its carburisation, and fusion; and accompanying this is the expulsion of carbonic acid from the limestone, and the union of the lime it contains with the earthy matters associated with the ore and fuel to form a fusible slag.

The circumstance of the different stages of the operation being effected at different temperatures has led some chemists to divide the interior of the furnace into a certain number of spaces or regions, and designate them according to the character of the action which was supposed to be carried on therein.

Scheerer, among others, assigns a distinct zone to the various steps of the process, namely:—

The Warming Zone.—That is the uppermost part of the furnace, twelve feet downwards from the mouth, in which the ascending current of gases imparts a portion of its heat to the materials just entering the furnace.

The Reducing Zone.—That is the next adjoining seventeen feet of the furnace, where the oxide of iron begins to part with its oxygen, and in which, also, the carbonic acid of the limestone is expelled.

The Carburising Zone adjoined to the former, and comprising about nine feet of the height of the furnace, where it is supposed that carbon unites with the iron.

The Zone of Fusion.—Supposed to be the next six feet of the furnace, in which the iron is melted, along with the earthy constituents of the materials, by means of the intense heat given off immediately below in the fifth, or *zone of combustion*.

It is into the last zone that the blast is admitted, the oxygen of which is converted into carbonic acid, which gas, coming in contact with incandescent coke, or charcoal, generates carbonic oxide to serve as reducing agent in the upper portion of the furnace.

Scheerer states the degree of temperature of those different zones to be 400° C., 1000—1200°, 1600—1700°, 1800°, and 2000—2650° C. respectively.

Tunner, of Leoben, has, by means of different alloys and various metals, attempted to determine the temperatures of blast furnaces, and he further endeavoured to ascertain by actual exposure of ore at different depths of the furnace the exact point at which reduction began and the rapidity with which it was effected. This he accomplished by placing in a box with the top and bottom provided with apertures, so that a portion of the gaseous contents of the furnace passing through its interior might heat and deoxidise any ore placed therein. This apparatus

was introduced into the furnace, and permitted to descend to different depths along with the usual materials, and was then drawn up by means of a windlass.

Tunner marks a depth of about 20 feet from the throat as the commencement of the process of reduction, which was reached twenty minutes after the ore was introduced into the furnace, and at which the temperature was as high as 700°C .

Ebelmen, by means of apparatus similar to that employed by Tunner, ascertained that reduction commenced at a depth of 8.2 from the top, and after the ore had been two hours in the furnace, and that it was completed at a depth of 18.9 from the throat after an exposure of 6h. 25m.

These investigations have induced them to assume lines of demarcation in blast furnaces (which are represented in sketches adjoined to the paper).

It is, however, doubtful whether any such lines can be laid down in blast furnaces, because to do this would require that each fragment of ironstone is descending with the same speed as all those introduced at the same time, and that every piece is susceptible of being deoxidised as rapidly as the remainder. Neither of these conditions takes place.

Besides, the friction of the materials against the sides of the furnace, particularly when they reach the slopes or boshes, retards considerably the descent of those portions exposed to its influence. The uniform motion of the mass downward is further liable to considerable disturbance by the smaller pieces of ironstone outrunning the larger by slipping through openings in the contents of the furnace, a mode of progress which cannot happen with those of larger dimensions.

Again, the size of the pieces of ironstone exercises a marked influence on the rapidity of the chemical action which the oxide of iron has to undergo during its passage through the upper portion of the furnace. A piece of ore containing a cubic inch of matter, will be perfectly reduced almost before any action has commenced on a second piece of ore, containing a cubic foot, supposing both pieces travelling side by side. In like manner the expulsion of the carbonic acid from the limestone is influenced.

The same delayed action will happen if a considerable quantity of small material is permitted to accumulate in a given portion of the interior of the furnace; indeed, there is perhaps no circumstance which more frequently deranges the operation than this.

The information which is sought to be obtained respecting the temperature of the different sections of a furnace is attended necessarily with considerable difficulty.

Tunner and Ebelmen's mode of judging of the rate of the reduction might be accepted as an indication of what it is under the most favourable circumstances as to size, inasmuch as in his apparatus of limited capacity he only introduced pieces of ore having very small dimensions. The very circumstance, however, of the mineral being incased within a box, introduces an element of difference between the samples under experiment and those in the furnace.

The lecturer's observations would indicate that the oxide of iron, when exposed to the unimpeded action of the gases of a blast furnace, is reduced at a temperature considerably below that assigned by any of the authorities already referred to, and, further, that the rapidity of the process is materially interfered with by any protection like that involved in the use of such a vessel. In order to form some judgment of the temperature and rapidity with which the oxide in the calcined oolitic ironstone of Cleveland was reduced by means of carbonic oxide, a glass tube was filled with pieces about the size of hemp-seed, and heated short of redness. In this state a stream of carbonic oxide was passed over it, and the resulting gas collected and examined. It contained 96 per cent of carbonic acid. A portion of the iron ore so treated was examined, and found to have in the space of 15 minutes lost 39 per cent of its oxygen.

After this a number of specimens of calcined ironstone were exposed at various times to the escaping gases of the furnaces for periods from 1 to 96 hours. Some specimens were placed on an open tray, others in a perforated box, about 6 or 8 feet from the furnaces in the tube for conducting the gas to the boilers, &c. The furnaces employed varied in height from 48 to 80 feet. The temperature of the gases rarely exceeded the lowest of the figures stated by Scheerer, Tunner, and Ebelmen, and frequently considerably below that. Conceding that the gases from the largest furnaces are the coolest, and from the smallest the hottest, the deoxidation is the most vigorous from the small furnaces, and generally speaking, decreases with each addition to its capacity.

The deoxidation of the iron ore to a certain degree increased with the length of time for which the ore was exposed, and amounted, in one instance, even to 100 per cent; the reduction of the ore placed in a perforated box and not on an open tray was sensibly interfered with. (Mr. Bell has adjoined a full list of his experiments to his paper).

In order to investigate whether the proportion of carbonic oxide contained in the gas might possibly affect the rate of the action on the ore, artificial mixtures containing 13CO , 16CO_2 , 71N , and 32CO , 6CO_2 , 21N , respectively, were separately passed over calcined Cleveland ironstone. Both results proved that almost complete conversion of carbonic oxide in carbonic acid takes place, and that the want of power of deoxidation is not due to a lesser proportion of carbonic oxide.

These and other trials prove that, although mass may retard the action and even delay it until sufficient heat has been imparted, these gases, at a temperature considerably below that stated by the foreign chemists, is sufficient to deoxidise ores of iron.

During the passage of the reduced iron through the furnace, and under the influence of the high temperature to which it is exposed, on its way to the hearth, the metal is apt to carry down some of those substances with which it was originally associated in its ore, or which it meets with in the flux or fuel. To such an extent may this occur that Fresenius quotes a case in which he detects not less than twenty substances other than iron in a specimen he analysed. In some cases as much as 22 per cent of manganese has been found, and above 5 per cent of silicon; but of all those elements mentioned by Fresenius, it is only carbon which may be looked upon as a necessary ingredient of all pig-iron. The circumstances which determine the union of this indispensable element with the metal is one of high interest. The portion of the furnace in which the combination takes place, the temperature necessary for effecting it, and the exact source of immediate supply, have engaged the attention of all chemists who have studied the subject. Scheerer assigned it something like the position before described. Tunner, by means of his perforated box, determined that carburisation did not take place until a depth of 29.8 feet from the top of the furnace was reached, at a temperature of about 1150°C . Ebelmen's idea of the zones of reduction and carburisation is somewhat higher up.

It was next enquired whether it is not highly probable that the box confining the iron ore has not interfered with the action of carburising in the same way as happened, in all probability, with that of deoxidising.

In order to ascertain the extent of change in content of iron, the samples were, after exposure, dissolved in hydrochloric acid, affording, of course, an insoluble residuum.

When a sample of calcined ironstone was exposed for the space of two hours in the waste gas, the residuum was of a greyish colour. The same may be said when the exposure was carried on for three hours with gases produced in the larger furnaces. The smaller furnaces evolve hotter gases—zinc in them frequently melting, and occasionally antimony. The insoluble residuum under consideration, from a specimen after three hours' contact with the hot

gases, was blackish, and this went on increasing as the exposure was prolonged, until it became perfectly black. On the other hand, larger furnaces having above $4\frac{1}{2}$ times the capacity (26,500 cubic feet instead of 6000) never gave off its gases, during a period of observation extending over 96 hours, hot enough to melt zinc; for during 72 hours of this time lead melted, and for the latter 24 hours bismuth only was fused. Ironstone exposed during 96 hours only afforded a greyish insoluble residuum on on being treated with hydrochloric acid.

From these observations it is concluded that an exposure of three hours to a temperature a little above the melting point of lead and below that of zinc sufficed to give the black colour, whereas at about the temperature at which lead fuses, no period up to 96 hours sufficed to produce it.

On examination the blackening was found to consist of carbon. This carbon, moreover, exists in such a minute state of division as to induce the belief that it is really combined with the iron; and it seems highly probable that the carburisation takes place at that comparatively low temperature. Neither does it appear that anything approaching to complete deoxidation is required, for in one case only 6.10 per cent of the oxygen of the ore was driven off, whilst the residuum was blackish, and with anything like 50 per cent of loss of oxygen, the colour is intensely black. On the other hand, oxygen may be removed to the extent, at all events, of 28 per cent, and no strongly-marked signs of carbon appear in the residuum if the heat during exposure has not reached the necessary point of elevation. In the case of the raw ironstone, the colour was much blacker than when the calcined ore was used.

[Owing to the great length of this lecture, we are obliged to defer the conclusion of our abstract, with the discussion, till next week.]

NEWCASTLE CHEMICAL SOCIETY.

A SPECIAL meeting of members of the Newcastle Chemical Society was held, on May 6th, in the theatre of the Newcastle College of Medicine, for the purpose of hearing a paper read by Mr. Ludwig Mond, on "*The Recovery of Sulphur from Alkali Waste.*"

In the absence of the President, whose paper on the "Blast Furnace" was read that evening before the London Chemical Society, Mr. JOHN GLOVER occupied the Chair.

The CHAIRMAN said that, as they were all aware, Mr. Mond was the patentee for the recovery of sulphur from tank waste. Of the importance of that discovery to the chemical trade of this district there could not be two opinions. He trusted that Mr. Mond would enable them, to some extent, to supply a felt want in the chemical trade in this district—namely, the profitable treatment of tank waste.

Mr. MOND, at the outset, said that thousands of pounds had been spent by chemical manufacturers to utilise the waste, or to carry it away, and no one but has had his nose offended and his appetite spoiled by going near waste heaps. In 1860, he commenced, in a chemical manufactory in Germany, a series of experiments on several processes for the recovery of sulphur from waste, and took out a patent in December, 1861. When he came to England (at the time of the Exhibition) he found, to his surprise, that a process, somewhat resembling his own, had been proposed as early as 1836. At the same time as himself, three different parties—in Glasgow, in Newcastle, and in Bristol—had been working in the same direction. His process, however, had clearly the merit of being the first that extracted great quantities of sulphur, and did away with the waste nuisance. He found the process a more expensive one in this country, where labour was dearer than in Germany. He found a difference in the English waste and that which he had been formerly accustomed to. In September of 1863, he took out the

new patent. He had previously experimented on tank-waste, and had obtained as much as 55 per cent of sulphur. The first to introduce his process on the Tyne was the Tyne Chemical Company, at South Shields. He believed that the waste of this district was more suitable for using his process than that of Lancashire, as being somewhat more porous. Mr. Mond then explained, by means of a diagram, the working of his process, and exhibited specimens of the sulphur obtained from the waste. He calculated that the cost of extracting the sulphur from the waste would be £1 per ton, but the profit to manufacturers would be about £4 per ton (at Messrs. Hutchinson's, it cost £1 5s. 5d. + 15s. for royalty = £2, working on a comparatively small scale). The cost of the apparatus he calculated to be £1,509, or (providing for all contingencies) £1,660. He thought that the alkali manufacturers ought to be satisfied with the process in a mercantile point of view, and, also, as it enabled them to remove a great nuisance.

The CHAIRMAN said that, whatever might be the opinion of the meeting as to the value of the paper—and that it was of great value no one could doubt—they were under a great obligation to Mr. Mond for the trouble he had taken in bringing so important a subject so very elaborately before them. He had no doubt that some of the gentlemen present would be able to offer comments on the process; he therefore invited any comments on or criticisms of the process, as detailed to them.

In reply to Mr. Archibald Stevenson, South Shields, Mr. MOND said that the waste treated in Holland during four years had been used for a great many purposes. The new station at Utrecht had been built on waste, and a number of the houses had been built upon it. A well, used for domestic purposes, had been sunk through the alkali waste, and the water, though very hard, employed for domestic purposes.

Mr. PATTINSON begged to move a vote of thanks to Mr. Mond for his very valuable paper. It appeared to him that Mr. Mond had solved the problem of disposing of soda waste. When the subject of utilising the waste products was mentioned to him, he had always said that the principal objection was the expense, and it was believed that the substance recovered would not pay the expense of the recovery. Mr. Mond had discovered a process by which they could recover sulphur from waste at a cheap rate; and, therefore, chemical manufacturers ought to be obliged to him for his discovery.

Dr. LUNGE, in seconding the proposition, said that there were two other processes—Schaffner's process and Hofmann's process—both of which involved a very large amount of labour. They involved the removing of the waste from the vat, exposing it to the action of the air for several weeks. He was in Germany last year, and visited a chemical manufactory where Schaffner's process had been introduced. He was told by the manager that they were modifying that process, and bringing it nearer to Mond's process. Schaffner's process had been given up wherever it had been worked, and Mond's process introduced—at least as far as the blowing of air and the decomposition of the liquors were concerned. The only detail of Schaffner's process retained, was the way in which the sulphur was converted into *roll*. As to Hofmann's process, Mr. Bell had mentioned, at the last meeting, that, in his opinion, Mr. Mond's process was a decided improvement on that process.

The CHAIRMAN said that Mr. Mond's process had been alluded to in the report of the commission appointed by Government with regard to the pollution of rivers. It might be that this process could be easily adopted; and, so far as chemistry was concerned, it was easy. But they must remember that there was an increasing manufacture of bleaching powder and of bi-carbonate of soda, and that these manufactures took up the whole of the muriatic acid. The muriatic acid required in Mr. Mond's process would, therefore, be taken up in the manufacture of bleaching powder and bi-carbonate of soda. Thus,

though the process was in itself valuable, seeing that it would, to a considerable extent, interfere with the manufacture of bleaching powder, its adoption for the purpose of reducing the nuisance felt from alkali waste was likely to be very limited.

Mr. MOND acknowledged the vote of thanks accorded to him for his paper, and, in reply to the remarks of the chairman, said that he would like to have an opportunity of going more fully than he would then be able to do into the question of utilising muriatic acid. As he had stated at the end of his paper, about 100,000 tons of strong muriatic acid flowed into the Tyne from alkali works during one year—or acid equal to 100,000 tons of strong muriatic acid. Believing that many manufacturers would be astonished at these figures, he explained how he had arrived at the conclusion. He found that so much salt was decomposed on the Tyne in the year, equal to so much strong acid. Now, the bleach and bi-carbonate made were also known; and, allowing quantities, very liberally calculated, for their preparation, he arrived at this remainder. The quantity of muriatic acid used for bleaching powder was considerably in excess of what was required. He believed that few manufacturers would be unable to find sufficient acid with which to treat their waste.

Mr. SCHOLEFIELD thought that Mr. Mond's figures were erroneous.

Mr. MOND said these were the figures given by Mr. Richard Cail, as Secretary to the Alkali Association, who, if he had been present, might have given them better information on the question than he could supply.

Mr. SCHOLEFIELD said that, if he had received information, he would have provided himself with correct details on the subject.

The CHAIRMAN thought that the figures given by Mr. Cail were likely to be quite correct.

Mr. MOND said that the quantity of acid required to do away with the waste nuisance was from 20 to 25 per cent of the acid. From 1866, the production of bleaching powder had greatly increased, but the production of bi-carbonate had not increased; the amount produced was not at all equal to that in 1866; and it was, therefore, likely that there would be a good deal of muriatic acid to spare.

In reply to a question, Mr. MOND said that the amount of brimstone used in England was 50,000 tons a year, and that the total amount exported from Sicily was 300,000 a year.

In reply to another question, Mr. MOND said he calculated that 40,000 tons of sulphur could be utilised from alkali waste in England in one year.

The meeting then separated.

FRENCH ACADEMY OF SCIENCES.

Monday, May 3rd, 1869.

A CONSIDERABLE portion of the time devoted to the meeting was occupied, as is too often the case with the *savants* who are seated there in the *fauteuils d'honneur*, to personalities.

General MORIN presented a report from the committee appointed to enquire into the alleged insalubrity attending the use of cast-iron stoves. The committee, of which the General was a member, has instituted a series of experiments on this subject at the Conservatoire des Arts et Métiers; the results arrived at are (1) all heating apparatus made of metal, and all stoves made of cast-iron, give off, while in use, a large quantity of carbonic oxide; (2) the quantity of that gas given off from stoves made of plate-iron, more or less thick boiler plate, is often insignificantly small; (3) the carbonic acid contained in the air is readily converted into carbonic oxide, by coming into contact with thoroughly red-hot cast-iron of the stoves made of that material; (4) the oxide of carbon

thus generated may, especially in confined localities, become very injurious to health.

The committee recommend to line the cast-iron stoves inside with fire-bricks, and to envelope them outside with a casing of sheet-iron, so arranged as to leave space for free circulation of air in communication with a well-drawing chimney.

On behalf of Messrs. Mille and Durand-Claye, Ingénieurs des Ponts et Chaussées, M. Dumas reports on the work undertaken by these gentlemen, viz., the useful application of the sewage water from Paris, taken at the bridge near Asnières. Every cubic metre of this water contains 1 kilo. of solid matter, and 37 grammes to the kilo. are nitrogenous matter. The engineers above-named treat this water with sulphate of alumina, whereby all the phosphoric acid, two-thirds of the nitrogenous matter, and rather more than one-half of the potassa salts present in the water are completely precipitated, and perfectly clear, inodorous water is left, which may either serve for irrigation of arable soil or meadows, or may be run off into rivers, without injury to the purity of the water of the same.

According to M. Morren, and contrary to the opinion given by M. Sarrasin, hydrogen and nitrogen gases become phosphorescent under the influence of an electric spark or galvanic current, provided the gases be perfectly pure, and under very reduced pressure. This statement gave rise to some discussion, since many of the *savants* present doubted the suitability of the means adopted by M. Morren to insure the purity of the gases at so low a pressure.

M. BERTHELOT read "*A Memoir on the Chemical Equilibrium between Carbon, Hydrogen, and Oxygen*," which we shall, probably, notice more fully at a future day.

Several papers were read about subjects relating to the geology of France, the meteorology and climate of the Isthmus of Suez, which, with some botanical papers, brought this meeting, as far as the public is concerned, to a close, at half-past five o'clock, p.m.

CORRESPONDENCE.

ON A REMARKABLE PASSAGE IN PRIESTLEY'S "LETTERS TO CANTON."

To the Editor of the Chemical News.

SIR,—Being engaged in arranging the Canton Papers, which belong to the Royal Society, I have come to a letter of Dr. Priestley, addressed to his friend, Mr. Canton, and dated "Leeds, 12th November, 1767." After describing some experiments on the melting of brass and steel wires by the electric shock, he concludes his letter in these terms:—

"You will think I talk strangely, but I own that these experiments, together with that of the insulated hot glass mentioned p. 716 of my book, and others too long to recite here, make me inclined to think there is no electric fluid at all, and that electrification is only some new modification of the matter of which any body consisted before that operation."

It is remarkable that Priestley here anticipates the theory which is now generally adopted by electricians. I cannot find, however, that he assumed it permanently, or decisively; on the contrary, he strongly inclined to Franklin's hypothesis of the positive and negative state of all electrified bodies. With a view to ascertain his opinion. I have examined the five editions of his "*History of Electricity*," and also his "*Familiar Introduction to the Study of Electricity*." He considers Franklin's theory to be "the most probable of any that have been hitherto proposed to the world" (*Hist. of Electricity*, part 3, § 2). After a full discussion, he speaks of it in the following terms:—

"Dr. Franklin, the author of this excellent theory of

positive and negative electricity, with a truly philosophical greatness of mind to which few persons have ever attained, always mentions it with the utmost diffidence. 'Every appearance,' says he 'which I have yet seen, in which glass and electricity are concerned, are, I think, explained with ease by this hypothesis. Yet, perhaps, it may not be a true one, and I shall be obliged to him who affords me a better.' "

At the time when Priestley and his friends were employed upon these researches, the celebrated Father Boscovich had attained to the summit of his fame. In the year 1760 he was elected a Fellow of the Royal Society, having visited London and enjoyed the intercourse of some of the most eminent philosophers of this country*. His theory of the constitution of matter, according to which it consists of centres of attraction and repulsion, had become generally known. Both Priestley and his friend and neighbour, Michell, had been interested in it†. We may infer that, in proportion as Priestley regarded with approbation "this sublime theory of the constitution of matter," he must have been inclined to regard electrical phenomena in the same light, which he has clearly propounded in the above-quoted passage.—I am, &c.,

JAMES YATES.

Lauderdale House, Highgate, N.,
May 8th, 1869.

ALKALI WORKS.

To the Editor of the Chemical News.

SIR,—I beg leave to ask the opinion of your readers to the following questions.

(1) Should not alkali works, when they are enrolled under an act of parliament, be exempt from proceedings at law, unless the prosecution is conducted by, and is the result of infringement detected by, the Government Inspector appointed for that purpose?

As a great many cases have, within the last year or two, been brought before the county courts by farmers, and, as the verdict, in the majority of them, has been against the manufacturers, notwithstanding that the Alkali Inspector has appeared as a witness on the opposite side to the farmers, and testified to the complete state of condensation at the time, the following other question suggests itself.

(2). Should not a special scientific legal court be formed for the trial of these cases.

The legal gentlemen connected with county court business laughingly admit their ignorance of chemistry, and at least one judge is exultingly spoken of by farmers as being "dead against chemical manufacturers;" and my impression is that there should be a proper tribunal, and the Inspector, and he only, should be the prosecutor. In Mr. Stevenson, M.P., South Shields (a large manufacturer of chemicals), and Dr. Lyon Playfair, we have good representatives, and I trust they will keep a vigilant look-out.—I am, &c.,

"AN INTERESTED PERSON."

May, 1869.

EQUIVALENCE AND QUANTIVALENCE.

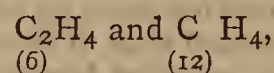
To the Editor of the Chemical News.

SIR,—Mr. Ward, in a communication to the CHEMICAL NEWS, of April 30th, appears to misunderstand the point referred to by Dr. Williamson, since he evidently confounds the terms *equivalent* and *atomic weight*. Your readers will, doubtless, admit the justice of Dr. Williamson's remarks, when they see clearly put before them the theory of equivalence and that of atomicity, or, as Mr. Ward well calls it, of quantivalence.

Let us take the two chlorides of phosphorus, PCl_3 and PCl_5 . The theory of equivalence asserts that, in the former, the equivalent weight of phosphorus is $\frac{31}{3}$, that of chlorine being 35.5; while that, in the latter, the equivalent weight of phosphorus is $\frac{31}{5}$; in a word, that the quantivalence of phosphorus is variable. Those who uphold the theory of quantivalence, assert that phosphorus is, under all conditions, trivalent. They maintain that, in compounds resembling phosphoric chloride, the two extra monad atoms (or what is equivalent to them) are combined with the phosphorous compound, in much the same way as that in which one salt combines with another salt to form a double salt. The quantivalence of phosphorus, according to this theory, is invariable.

It would be difficult to find two theories more antagonistic than these. It was, therefore, with great justice that Dr. Williamson complained that many chemists employ the terms equivalent and atomicity indiscriminately; seeing that the former implies a variable, the latter an invariable, quantity.

It is necessary to draw attention to the abuse of the word "fact" in Mr. Ward's letter. He does not distinguish clearly between a *fact*, and a *theory* founded upon facts. The equivalent weight of an element in any particular compound is a fact; its atomic weight and its quantivalence are theories founded upon facts. All chemists agree that, in marsh gas, the equivalent weight of carbon is 3, that of hydrogen being 1; but some ascribe to carbon the atomic weight 6, others 12; and hence we have the different molecular formulæ—



both representing marsh gas. In the same way, some assert that carbon is divalent; others that it is tetravalent. If the atomic weight and the quantivalence of carbon were facts, what ground would there be for any dispute?—I am, &c.,

TEMPLE A. ORME.

University College School, London,
May 8th, 1869.

A PLEA FOR THE WORD QUANTIVALENCE.

To the Editor of the Chemical News.

SIR,—Most chemists seem disposed to accept the notion of atomicity, but apparently object to the word itself. The ideas conveyed by the terms monatomic (H' , &c.), diatomic (O'' , &c.), triatomic (N''' , &c.), tetratomic (C'''' , &c.), more or less modified, are generally agreed to, the names themselves rejected. The cause of this rejection is found, doubtless, in the fact that, instead of conveying to the mind the intended impression of the single, double, triple, and quadruple *value* of atoms in forming molecules, the words monatomic, diatomic, triatomic, and tetratomic give the erroneous impression of *number*; a diatomic body, for instance, is liable to be regarded as containing two atoms, whereas double value alone is intended. In place of these names those of univalent, bivalent, trivalent, quadrivalent, about which there can be no ambiguity, are being adopted by leading chemical authors; but as to which of the words *equivalence* and *quantivalence* shall displace *atomicity* there is difference of opinion. The appellations "equivalence" and "equivalent" are claimed as well known and as covering all the ground commanded by "quantivalence." This they do, undoubtedly, but the objection to them is that they do much more and, from their relative nature, possess any meaning required by the context. The word *equivalent* (with which *equivalence* is indissolubly connected) is not only frequently required and used, and rightly so, by chemical and other authors in several different general senses, but, employed in reference to a chemical atom, it may properly be intended to have distinct meanings. Thus, in regard to the exchangeable

* Fabroni, "Elogi," Tomo ii., p. 41; Rees's "Cyclop.," vol. v. article Boscovich.

† Priestley, "History of Discoveries relating to Vision." "Inquiries relating to Matter and Spirit," vol. i., p.p. 24-42.

values of atoms of chlorine, oxygen, nitrogen and carbon their respective equivalents are commonly 1, 2, 3, 4, while in displacing 1 part by weight of hydrogen their equivalents will be $35\frac{1}{2}$, 8, $4\frac{3}{8}$, 3, and in forming molecules, $35\frac{1}{2}$, 8, 14, 6, according to old notions, and $35\frac{1}{2}$, 16, 14, 12, according to new ideas. To speak of atomicity (or the subjects of univalence, bivalence, trivalence, and quadrivalence), under the general term *equivalence* is to place unnatural restrictions on the latter word, and divorce the term *equivalent* from proper associations. On the other hand, *quantivalence* is open to none of these objections, and fully satisfies all requirements.

The philology of the matter is indisputable. Let us have either monatomic, diatomic, triatomic, and tetraatomic, or univalent, bivalent, trivalent, and quadrivalent; not such hybrids as biatomic or divalent. Pupils of indifferent education also need sometimes to be reminded that the correct pronunciation of the quan-tiv'-a-lence terms is u-niv'-a-lent, biv'-a-lent, triv'-a-lent, quad-riv'-a-lent.—I am, &c.,

JOHN ATTFIELD.

17, Bloomsbury Square.

MISCELLANEOUS.

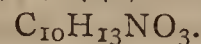
Statue to Oersted.—We learn from *Cosmos* that a committee has been formed at Copenhagen with the intention of erecting a suitable monument in honour of the great Danish *savant*. A statue, representing the illustrious man, is ordered to be made by a Danish sculptor, named Ferichau, and is intended to be placed in a prominent situation in the capital of the kingdom.

Accident to Professor Bunsen.—The *Carlsruhe Gazette* relates that an accident the other day befel the celebrated chemist Bunsen. He had prepared a quantity of a composition recently discovered, and had dipped his fingers in the vessel, to see if the composition was dry, when that slight pressure sufficed to ignite the whole mass, and a flame arose, which scorched the experimentalist rather severely in the hands and face. He is expected, however, to recover in the course of ten days or a fortnight.

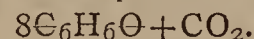
CHEMICAL NOTICES FROM FOREIGN SOURCES.

Journal für Praktische Chemie, 1869, No. 2.—This number contains the following original papers:—**Researches on some New Minerals.**—M. R. Hermann, having the opportunity of sorting a parcel of minerals from Nishny-Tagilsk, Russia, found among these one which, in consequence of its outward similarity to copper lazurite, *kupferblau*, attracted his attention. On testing it qualitatively, however, he discovered that, unlike the mineral just named, the substance he had to deal with contained, besides silica, oxide of copper, and water, also a large quantity of phosphoric acid. The mineral was named by him *cyanochalcite*; it is a tough substance, its fracture is even, it is transparent at the edges, has a sky-blue colour, its hardness is 4.5, and its specific gravity 2.79; on being heated, it loses water and becomes black; before the blowpipe it gives the reactions of copper; is readily soluble in hydrochloric acid, does not effervesce with acids, while on becoming dissolved silica is separated in the shape of a powder; molybdate of ammonia added to its solution indicates phosphoric acid. Results of analysis gave, for 100 parts:—Silica, 26.90; phosphoric acid, 6.95; oxide of copper, 49.63; water, 16.52. The genuine copper lazurite contains 45.5 per cent of oxide of copper, but no phosphoric acid at all. Hydrargillite, from Chester county, U.S.:—Hardness, 3.0; specific gravity, 2.35; infusible before the blowpipe. Contains in 100 parts:—Phosphoric acid, 0.91; alumina, 63.84; water, 33.45; silica, 1.50; and traces of magnesia and peroxide of iron. Wavellite, from the same county, contained:—Phosphoric acid, 32.70; alumina, 35.83; water, 28.39; peroxide of iron, 3.08; and a trace of fluorine. The hardness of this mineral was 3.5; its specific gravity 2.30. On a **Constituent of the Resin from the Ferreira spectabilis**.—It appears that in the Brazils there is in use, as a febrifuge, a resin, known in some parts of the country as *sulphato*, in others as *Resina d'angelim pedra*. When this resin is first digested with water, which removes colouring matter, the residue dissolved in water acidulated with hydrochloric acid, and the crystals thereby obtained first purified with water, next with absolute alcohol, again dissolved in hot water, and

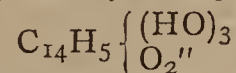
this solution treated with ammonia, a substance is precipitated which has been named *angelin*; this material had been sent from Cantagallo to Vienna, and was thence forwarded to Praguc, to Dr. Gintl, for examination and report. That gentleman, after very exhaustive qualitative and quantitative researches, found, on elementary analysis of the frequently-purified substance, that it consists, in 100 parts, of:—C, 61.51; H, 6.81; N, 7.26; O, 24.42; formula—



Dr. Gintl further found that angelin is in all respects identical with Ruge's ratanhia, also in its behaviour with nitric acid, by which both these substances are first made rose, next ruby-red, and finally deep violet coloured, provided only dilute acid be applied, and heated very gradually and gently. **Acetonic Acid.**—This acid is prepared in the following manner:—Aceton, hydrocyanic acid, and dilute hydrochloric acid are mixed, and then left standing together for three weeks; after this time the mixture is boiled on a water-bath for three days in a retort or flask with a condenser attached to it, and so arranged as to admit of the reflux into the retort of the greater part of the condensed liquid; the residue is then treated with ether. After evaporation thereof, a sour yellow extract-like substance is obtained, which contains acetonic, formic, hydrochloric acid, and still a little hydrocyanic acid; this mass is again concentrated by evaporation, then diluted with water, boiled, and while boiling neutralised with carbonate of zinc. After filtration the filtrate yielded acetate of zinc; this was diffused through water, and the zinc removed by sulphuretted hydrogen, the sulphide of zinc having been separated by filtration, the acid after a time was obtained in solid crystals by slow evaporation. It is a solid, very readily soluble in water, alcohol, and ether; it sublimes when quite dry, and fuses at 79° C. The acetate of zinc is a difficultly-soluble salt, which contains 24.59 per cent of zinc. On a **Combination of Hydrate of Phenyl and Carbonic Acid.**—M. Barth caused some porous substances to become impregnated with the hydrate of phenyl, and placed these in the iron vessel belonging to Natterer's apparatus for condensing carbonic acid; he then condensed some of that gas in the said vessel, and, on inspection after a few days, he found that the phenyl-alcohol had been converted into a mass of crystals very like those which the cubes of common salt form when agglutinated together. Barth found that these crystals contained carbonic acid, and a series of quantitative experiments proved the quantity of that gas to be from 5 to 5.5 per cent; the crystals fused at 27° C. on exposure to air, and very frequently were forced asunder with a sharp report; when one breathed over these crystals, they became covered with a slight foam. The compound is represented by the formula—



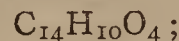
Bulletin Mensuel de la Société Chimique de Paris, March, 1869.—This number contains the following original articles:—**Researches on the Milky Juice of the Antiaris toxicaria.**—Dr. De Vry and M. E. Ludwig have made researches on this substance, the produce of a tree which grows wild in Java, the juice of which, here alluded to, is applied by the natives to poison arrows; the specific gravity of the juice is 1.06; on evaporation it leaves 37.9 per cent of a brown resin. This resin, treated with warm petroleum (boiling at 60°) and with absolute alcohol, leaves 47 per cent of substances insoluble in these fluids; the petroleum dissolves an amorphous, and also a crystallisable resin, some fatty matters, and caoutchouc. The alcoholic extract contains antiarine, an acid, and a saccharine substance, while the insoluble portion is albumen. The antiarine is a glucoside, which can be split up into sugar and a yellow resin; its composition in 100 parts is expressed by—C, 61.2; H, 8.1; O, 30.7. The crystallisable resin, differing from the resin antiar described now about forty years ago by Mulder, contains in 100 parts—C, 83.9; H, 11.9; O, 4.2. On the **Colouring Matters of the Anthracen Series.**—MM. Graebe and Liebermann have found that when purpurine (extracted from madder root) is heated with powdered zinc, anthracen is obtained identical to that which alizarine yields when distilled with zinc. When purpurine is treated with reducing substances it yields, as also does alizarine, a colourless substance, which oxidises in the air, and then yields again purpurine. From these and other reactions the authors infer that purpurine is oxyalizarine, or trioxanthraquinone—



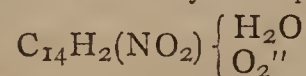
Chrysophanic acid has been considered by Rochleder as represented by—



while Gerhardt expressed its constitution by—



this acid yields, with nitric acid, chrysammic acid, which, according to the authors of this paper is tetranitroxanthraquinone—



Aloine, treated by powdered zinc, has also yielded anthracen; aloine yields chrysammic acid when treated with nitric acid. Gentianic acid—



and euxanthone—



have been likewise treated by zinc; these acids did not yield anthracen, but other hydrocarbons. **Iron in Milk.**—M. Bistron has found that the milk of the female goat contains on an average 0.1 grm. of iron in 1,000 parts of milk; this quantity of the metal appears to be constantly present in that fluid, and corresponds with the quantity

found in the milk of women. **On the Application of Alkaline Iodides as Reducing Agents.**—M. Berthelot read a short paper on this subject at the meeting of the Paris Chemical Society, relating his experience in this respect, and stating that though iodide of potassium is in many instances more preferable to use than hydroiodic acid, it is less active than that substance. The same applies to iodide of ammonium; this is explained by the author to be caused by the greater stability possessed by these compounds. **On the Use of Protoxide of Thallium as an Ozonoscopic Substance.**—M. Lamy communicated, at the meeting of the Society, the following observations made by him concerning this subject as the result of a series of experiments made during a year, not only in Paris, but in divers parts of France, including some remote mountainous districts:—(1) Protoxide of thallium assumes a brownish tinge, even when out of reach of any air or ozonised oxygen; (2) the sensitiveness of the thallium paper varies according to the degree of concentration of the solutions which have been applied in preparing it, or their more or less advanced state of carbonation; (3) recently-prepared thallium paper is more sensitive to ozone than paper prepared with starch and iodides; (4) the more or less dark colour of the thallium paper only, then, indicates ozone when that same paper afterwards renders tincture of guaiac blue when moistened with that fluid; (5) when this condition is properly attended to, protoxide of thallium paper is very fit to indicate rapidly and with certainty ozone, even in an atmosphere containing nitrous acid fumes; but this paper can only serve as a reagent for ozone, and is not fit for showing any quantity thereof in the atmosphere. **On the Action of Light upon Sulphide of Carbon.**—Many of our readers have had the opportunity of noticing that the bottles, especially if made of white glass, containing sulphide of carbon often become lined, if exposed for any length of time to direct sunlight, with a coating strongly adhering to the glass. M. Locw has experimented on this substance, by enclosing the sulphide in sealed glass tubes previously moistened with water, which has the effect of lessening the adhesiveness of the brownish coating. On opening the sealed tubes after a few months' exposure to sunlight, the water was observed to have an acid reaction, due to the formation of some formic acid; the solid substance alluded to is insoluble in alcohol, chloroform, ether, and sulphide of carbon, but soluble in a boiling solution of caustic potassa, becoming, however, at the same time decomposed. The substance is sesquisulphide of carbon, which, on being submitted to distillation, is decomposed, yielding sulphur and carbon; the sulphide of carbon from which this substance is deposited contains sulphur in solution, though perfectly pure previous to exposure to sunlight. **Estimation of Suboxide of Copper occurring in Metallic Copper, and especially in the Variety of this Metal known as Rosette.**—When dilute sulphuric acid acts upon suboxide of copper in the presence of nitrate of silver, the suboxide is split up into metallic copper and oxide of copper, which becomes dissolved as sulphate, while the metallic copper takes the place of the silver of the nitrate of that metal. In order to apply this reaction for analytical purposes, M. C. Aubel takes 0.5 gramme of the copper to be tested, previously reduced, by proper mechanical means, to powder or filings; he adds 1.3 grm. of solid nitrate of silver mixed in a mortar with 10 c.c. of dilute sulphuric acid. The decomposition sets in at once, and is entirely complete after two hours' time; water is then added, the metallic silver is collected on a filter, well washed, and, after having been dried, is weighed. **Volumetrical Estimation of Chromic Acid.**—M. C. Zulkowsky adds to the chromic acid solution a sufficient quantity of iodide of potassium, free from iodate, and pure hydrochloric acid. This mixture is left quietly standing for from half an hour to a few hours' time, according to the degree of concentration of the solution, for in no case is the reduction of the chromic acid by means of the hydriodic acid instantaneously effected. When the reduction is complete, which may be learned from the pure green colour the liquid has assumed, a small quantity of thin starch paste is added, and the quantity of iodine which has been set at liberty is estimated by titration with a solution of hyposulphite of soda. Quantitative test solutions are prepared by dissolving 24.8 grms. of hyposulphite of soda in a litre of water, and 4.9196 grms. of bichromate of potassa also in a litre of water; by this arrangement 1 c.c. of the first solution is equal to 1 c.c. of the chromate solution containing exactly 0.003349 grm. of chromic acid. **Testing Sulphate of Quinine.**—M. Panot applies, for the purpose of ascertaining the presence of salicine in sulphate of quinine, the well-known action of oxidising substances upon salicine, and the transformation of the hydride of salicyl into a substance which, under the influence of perchloride of iron assumes a bluish violet colour. The suspected sulphate of quinine is placed in a flask, to which, by means of a perforated cork, a glass tube can be fixed; then 2 c.c. of dilute sulphuric acid (1 of acid upon 4 of water), and 4 c.c. of a saturated solution of bichromate of potassa, are poured into the flask; heat is applied to the flask, and its contents brought to boiling, while the products of the distillation carried off by the glass tube are collected in distilled water. When the reaction ceases, some few drops of a solution of chloride of iron are added to this distilled water, and, should a violet colouration ensue, this will be evidence of the adulteration with salicine of the sulphate of quinine; the presence even of $\frac{1}{2}$ per cent of salicine is very readily proved by this process.

On the Characteristic Differences and Tests for the Detection of some Fatty Oils.—Dr. Sacc, of Neuchâtel.—(*Rev. Hebd. d. Chim.*, No. 22, 1869.)—Although the fatty oils are nearly all compounds of fatty acids and glycerine, there exists among them so much difference of physical properties that there is good cause to assume that the diversity of taste and the colour and odour exhibited by these oils is due to very slight differences in chemical characters, and hence behaviour with reagents, which the author has endeavoured to find out, and thereby render the detection of adulteration a more easy matter. **Olive oil.**—Colour light yellow, odour faint; heated to nearly its boiling point it decrepitates, in consequence of having retained slight traces of water, and becomes discoloured without further change. A

mixture of equal bulks of oil and of nitric acid of 1.31 sp. gr. at 55° F. does not at the ordinary temperature produce any change. Sulphuric acid of 1.76 sp. gr., and at 55° F., unites with the oil, the mixture becomes hot, dark coloured, and, on addition of cold water, the dark mass, while dissolving therein, becomes white. Commercial acetic acid has no action whatever upon the oil; caustic soda lye of 1.04 sp. gr., at 55°, produces, even in the cold, a white emulsion; alcohol of 90 per cent floats on the oil, but does not dissolve it. Ether, benzol, light petroleum, naphtha, sulphide of carbon, and spirits of turpentine dissolve the olive oil and all the following oils. A solution of nut-galls, of 100 grammes weight of galls to the litre of water, does not change olive oil when mixed therewith; this reaction enables us to distinguish between ground-nut and sesame oil, with both of which olive oil might be confused. Caustic ammonia readily forms a beautifully-white emulsion with this oil, which is not at all acted upon by solutions of nitrate of silver and chloride of gold. **Colza Oil.**—Golden yellow colour, faint odour, somewhat resembling that of turnips; when heated to boiling point its colour becomes lighter. Nitric and acetic acids do not act upon this oil; sulphuric acid, when mixed with this oil, evolves much heat, while a dark brownish mass is formed, which, on being dissolved in water, becomes white; caustic soda solution and liquid ammonia form emulsions with colza oil, which is insoluble in strong alcohol and specifically heavier than that fluid. Solution of nut-galls forms an emulsion, and the same is also the case with chloride of gold and the oil; nitrate of silver causes a turbidity in the oil, and appears to become partly reduced to metal. **Oil from *Arachis hypogæa*: Ground nut oil.**—Light straw-yellow colour; odour faint; no change when heated to boiling point, and becomes turbid and more dark yellow coloured on addition of nitric acid; addition of sulphuric acid evolves much heat and changes it, as did the same acid when added to colza oil; with soda solution and with solution of nut-galls the same behaviour as the foregoing, ammonia also as the foregoing, and alcohol the same; no action with nitrate of silver, while chloride of gold forms an emulsion with this oil, and becomes partly reduced to the metallic state, perceptible by a violet colouration. **Nut oil.**—Bright lemon yellow; odour acrid; heated, it boils quietly, and its colour becomes less deep; is rose-coloured by nitric acid, but the colour disappears very rapidly, and a slight turbidity is produced; with sulphuric acid a great heat is developed, and the oil obtains a cinnamon-brown colour; the mixture swells upon being placed in water, becomes white, and a portion of oil which had not been apparently acted upon floats on the top of the water. Acetic acid, soda solution, and solution of nut-galls do not act upon this oil at all; alcohol does not dissolve it and floats on it; nitrate of silver causes a slight turbidity, while chloride of gold is readily reduced by the oil. **Whale oil.**—Dark yellow coloured; odour very disagreeable and nauseous; on being heated, the oil boils readily and without spurting; nitric acid produces a bitter colouration; sulphuric acid develops very little heat, and causes a cinnamon-brown colouration. When the mixture of this acid and oil are placed in water it becomes white and disengages an odour somewhat resembling that of asphalt. Acetic acid and solution of nut-galls are without action upon this oil; with soda solution a yellow emulsion is formed; alcohol does not dissolve it; liquid ammonia forms a yellow emulsion; nitrate of silver, no action; chloride of gold, traces or no action. All the reactions before-mentioned have been made with equal bulks of oils and reagents in test-tubes at a temperature of from 15° to 20° C., and the substances have been left in contact for thirty-four hours; this also applies to the following experiments:—**Cotton-seed oil** (of course refined).—Bright orange yellow colour, faint odour, no change on being boiled; becomes brown at the points of contact when treated with nitric acid. Sulphuric acid causes evolution of much heat, changes it into a brown mass, which, on being placed in water, becomes white and dissolves therein; acetic acid and nitrate of silver have no action upon this oil; solution of soda and liquid ammonia form emulsions with difficulty with the oil, which is itself insoluble in alcohol; solution of nut-galls causes an emulsion, as does also a solution of chloride of gold, which is, moreover, perceptibly reduced to the metallic state. **Sesame-seed oil.**—Colour bright yellow; odour faint; becomes nearly colourless when heated to boiling point. With nitric acid, bright orange colour; with sulphuric acid, evolution of heat, dark brown colour, and, on addition of water, violet colour, and soluble therein (it should be observed that sulphuric acid really saponifies most of these oils, and that the soap so formed is soluble in water added in excess); acetic acid, no action; with soda, ammonia, and nut-gall solutions, emulsions are formed, all of which exhibit a white colour; not soluble in alcohol, and thickens on addition of nitrate of silver. Chloride of gold causes formation of an emulsion, and is itself perceptibly reduced to the metallic state.

PATENTS.

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

982. J. C. Lee, Ashton-on-Mersey, Cheshire, "Certain methods of collecting excreta, and of treating the same in order to render them comparatively innocuous, and to obtain a useful product or useful products therefrom."—Petition recorded April 1, 1869.

1256. H. E. Newton, Chancery Lane, "Improvements in puddling iron."—A communication from C. Hewitt, Trenton, New Jersey, U.S.A.—April 23, 1869.

1278. T. Forster and P. B. Cow, jun., Streatham, "Improvements in compounds containing India-rubber, gutta-percha, or balata, and in the manufacture of such compounds."—April 24, 1869.

1317. A. Meredith, Newgate Street, London, "Improvements in the manufacture of iron and steel."—April 28, 1869.

NOTICES TO PROCEED.

3930. W. H. Walenn, Tufnell Park, West Holloway, Middlesex, "Improvements in the electric deposition of copper and brass."—Petition recorded December 24, 1868.

3967. S. F. Henley, Pimlico, Middlesex, "Improved means of operating upon stick or gum lac, for the extraction of colouring matter or lac dye, and for the production of shell-lac."—December 30, 1868.

4. W. M. Williams, Sheffield, "Improvements in fettling or lining puddling furnaces used in the manufacture of iron and steel."—January 1, 1869.

164. A. M. Clark, Chancery Lane, "Improvements in the manufacture and refining of sugar."—A communication from L. J. F. Margueritte, Boulevard St. Martin, Paris.—January 18, 1869.

1178. G. T. Bousfield, Brixton, Surrey, "Improvements in the manufacture of heavy hydrocarbon oils, and in apparatus used therein."—A communication from J. Merrill, Boston, Mass., U.S.A.—April 16, 1869.

NOTES AND QUERIES.

On the Cause of a Pink Colour in White Lead Corrosions.—It appears, from the experiments of Mr. W. Baker (*Phil. Mag.*, May, 1869), that not, as he formerly supposed, oxide of copper, but metallic silver, when present in lead in small quantity, is the cause of the pink colour now and then observed by white lead manufacturers. Analysis of 5,000 grs. of white corrosion gave:—CuO, 0.0050; FeO, 0.0022; NiO, trace; Ag, 0.005, per cent. Pink corrosion:—CuO, 0.0060; FeO, 0.0022; NiO, 0.0013; Ag, 0.0058 per cent. A decided colour, which is uniform throughout the mass of the corrosion, is obtained when the silver amounts to about 1½ ozs. per ton. The author ascertained that the silver is present in metallic, but of course finely-divided, state.

Discovery of Natural Gas.—Some workmen, while boring for water at Middleton Hall, Uphall, Linlithgowshire, observed that gas escaped from the bore-hole. They applied a light, and instantly the gas blazed up in a beautiful white light, and continued to burn with increasing force, until it was extinguished by the workmen in order to resume their boring operations. The stratum from which the gas evolves is well known to mineralogists as the marl which overlies the rich bituminous shales of this district. Judging from the extent of the source of supply, and the richness of the gas, it might be profitably employed for heating and illuminating purposes, and the shale worked for oil making. The parish of Uphall is contiguous to Bathgate, well known for the Boghead coal being found in its neighbourhood.

Mutual Decomposition.—In the employment of common reagents in an aqueous analysis, it is usual for the test employed and the substance sought, if present, to mutually decompose each other, and to form salts of a different nature—for example, the determination of sulphuric acid in a soluble sulphate by means of a soluble salt of barium; the acids in this case are transposed, because of the stronger affinity of the acid of the first base for the base of the second. But in the dry way it frequently happens that, at an elevated temperature, acids and bases lose the stronger affinity, and combine with other bases and acids, for which at ordinary temperatures they have a lesser affinity—for example, sulphate of baryta and carbonated alkali. Now, in the case of a mixture of sulphate of lime and carbonate of magnesia, I had no standard chemical work for reference to ascertain whether, on application of heat, these salts undergo decomposition—carbonate of lime and sulphate of magnesia resulting, or more probably caustic lime and sulphate of magnesia, as such was my impression; hence my note appearing in your issue of the 23rd ult. I am obliged for your answer of last week, but thinking so an apparently simple matter—as to whether these salts do or do not decompose at a high temperature, say a red heat—must be well known to those skilled in chemistry, is my excuse for again writing.—W.

Purifying Water.—(*Report of the Netherlands Committee.*)—It is a well-known and generally-observed fact that the water of rivers, canals, and some lakes is never quite clear. This turbidity, which often remains even after many days of quiet rest, is partly due to inorganic substances floating about in the water and suspended therein, but is far more frequently caused by matters of an organic nature too minutely divided and too small to be readily recognised, even by a powerful microscope. The researches of some of the members of this report have undeniably proved that, at least as far as the Netherlands waters they submitted to research are concerned, this turbidity is due to extremely minutely-divided clay, by the aid of which a great deal more of organic matter than could otherwise remain suspended is kept in such an extreme state of division as to pass through filters and not deposit, even after many days of rest. When, to such kinds of water, a solution of alum (from 1-50,000th to 1-100,000th of the bulk of the water) is added, it will be observed that after a longer or shorter lapse of time a flocculent precipitate is formed, which is either alumina or a basic sulphate thereof, which flocculent material takes up all the turbidity of the water, leaving that perfectly clear; the precipitate thus formed has been submitted to chemical tests, and it was found to contain a large quantity of organic matter, and to yield, on being heated with soda-lime, ammonia very largely. Since the committee was instructed to ascertain and discover the means of improving the condition of the potable waters where it was required, this especially also applied to the towns and villages whose chief supply of water for domestic and drinking purposes depends upon that of the river Maas, along the banks of which, in the lower portion of

its seaward course, the population is entirely dependent upon its water; which has been almost from time immemorial known to produce, in those not accustomed to its daily use, a diarrhoea, which in certain individuals is accompanied by very unpleasant, if not always, therefore, dangerous symptoms. The water of this river has been analysed over and over again by many eminent scientific chemists, and has been submitted to microscopic research, but no trouble, nor anything science could, armed with its best weapons, bring to bear on this research, has ever revealed the precise cause of this peculiar property, which is not possessed by the water of the same river, nor also by that of the Rhine, higher up its course. For curiosity's sake, we here quote the result of one of the most recent analyses of this water taken at flood tide at Rotterdam:—Physical properties—very turbid, does not become clear on standing, is not rendered clear on addition of a few drops of hydrochloric acid; taste—not quite unpalatable; solid residue—dried at 120° C., yielded, for 1 litre, 0.195 grm., containing 0.055 of combustible matter; earthy salts—0.0975 grm., containing 0.048 sulphate of lime, chlorides of alkalies, 0.0233; ammonia—none; slight trace of nitrates; dry residue had a yellow colour before ignition. It is a highly-important fact, and one of very general importance to learn, that Dr. J. W. Gunning, of Amsterdam, has found that the perchloride of iron added to this water (and the same applies to far more foul waters experimented upon) has the effect of rendering it perfectly wholesome and even agreeable for use. To one litre of water, 0.032 grm. of the dry salt just alluded to, and previously dissolved in pure water, are added, and, after well stirring the liquid, it is left quietly standing, to settle, for fully thirty-six hours. A series of very carefully-made experiments has proved that no free hydrochloric acid (the quantity thereof contained in the above-stated weight of perchloride of iron only amounts to 0.021 grm.) was left in the clarified and purified water, but in order to suit the application on the large scale, and to make assurance doubly sure, as regards any acid or perchloride being left undecomposed, or rather uncombined, with the organic and inorganic matter of the water, Dr. Gunning has advised that a small, but equivalent, quantity of crystallised carbonate of soda should be also added some hours previous to beginning to take the purified water for use. At Dr. Gunning's request, a scientific gentleman of high attainments, who happens to have an excellent opportunity, near Rotterdam, to try on the large scale this process, has submitted it to practical test, and a quantity of no less than about 240,000 litres of Maas water, taken at all times of the year, has been treated by this process, and thereby rendered perfectly fit for use, and consumed by various parties, has proved to have been entirely deprived of its property of causing diarrhoea; moreover, the medical officer in charge of the crew of Her Majesty's corvette the *Lynx*, moored off Rotterdam, in the river, has applied this process to the water taken from the river, and found by experience that the thus purified water has even the good effect of restoring to health such of the crew as had been incautiously drinking the not previously purified Maas water. It is, when using this means of purifying bad water, of great importance to let the sediment quietly settle; it occupies about 4-10ths of the bulk of the water, which on the large scale will, for security's sake, be submitted to a filtration through fine well-cleansed sea-sand before being sent through the mains of the large waterworks intended to be established near Rotterdam for the supply of that town. The quantity of crystallised carbonate of soda which is equivalent to 0.032 grm. of dry perchloride of iron is 0.085 grm.; both these quantities are the maximum required to render the Maas water perfectly pure, even at the time when it is most turbid; comparative experiments have conclusively proved that the application of this process is very superior to filtration of the water, even through animal charcoal. The result obtained with the Maas water having been so eminently successful, the committee has applied this method to the purifying of water otherwise non-drinkable, such as is met with in many of the smaller canals, brooks, and also pumps yielding surface water of bad quality in many parts of the kingdom, and the results obtained are such as to justify the order that this method of purifying must be applied by authority to a class of waters which, thus treated, become available for use. The precipitate formed by the addition of the perchloride of iron and carbonate of soda, both previously dissolved, has been proved, by accurate analysis, to contain a large quantity of organic matter, which, on being ignited with soda-lime, yielded ammonia very largely; analysis has also proved that, as regards the Maas water, the only addition to its inorganic constituents is that of one part of chloride of sodium, by weight, in 40,000 parts of water by the application of this process. Dr. Gunning has found that the effect of the perchloride is not so conspicuous with some well waters containing much carbonic acid; while, moreover, there may exist in some of these kinds of waters, either in quantity or quality, inorganic salts which delay or altogether impede the peculiar mode of flocculent precipitation observed with the above-named Maas and other waters to take place after addition of the iron salt.

MEETINGS FOR THE WEEK.

TUESDAY, 18th.—Royal Institution, 3. Professor Grant, "On Stellar Astronomy."

WEDNESDAY, 19th.—Society of Arts, 8.
— Pharmaceutical (Anniversary), 11.

THURSDAY, 20th.—Royal Institution, 3. Professor Tyndall, "On Light."
— London Institution, 6.
— Zoological, 4.
— Chemical, 8.

FRIDAY, 21st.—Royal Institution, 8. Professor Jenkin, "Submersion and Recovery of Submarine Cables."

SATURDAY, 15th.—Royal Institution, 3. Prof. Seeley, "On Roman History."

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THE CHEMICAL NEWS.

VOL. XIX. No. 494.

ALKALI WORKS.

WE inserted last week a letter from an alkali manufacturer urging that if alkali makers comply with the "Alkali Act," no farmers or other persons ought to be allowed to complain. This is a bold position. He forgets that the Alkali Act controls one gas only. We suppose he is an Englishman, and yet he wishes to take from his countrymen the right of grumbling—the right of petition and complaint. We doubt if Parliament, with all its power in this respect, can interfere. Besides, the Alkali Act does not demand perfection from the manufacturers. It was established to diminish an evil in such a manner that it should not hurt the manufacturers; but it did not attempt to decide whether the 5 per cent of muriatic acid allowed to escape could under any circumstances injure any person. We know that coal smoke will damage plants, because of the sulphurous acid in it, small as it is; we conclude, therefore, with certainty, that any addition of acid will injure them yet more; and 5 per cent of escape from an alkali works may probably injure in cases where the total amount given out is great and the fields readily struck.

Admitting that an alkali maker is very far from infringing the Alkali Act, is he always equally innocent of doing mischief by gases not mentioned in it? Weight for weight sulphuric acid is in reality more dangerous to plants than muriatic acid. It is extremely heavy, and a little does much evil, because it does not readily disperse. Now, do the alkali makers and sulphuric acid makers keep all their fumes to themselves? We have no information as to the alkali makers, but we have heard of a man, not an alkali maker, who lets go 20 per cent of his sulphuric acid. We enquire of the Inspector of Alkali Works, and what does he say?—He is very sorry, but he has no right to interfere, or even to enter the works. If he were asked his opinion of such a work—supposing it were also an alkali work—he would say that, so far as he is concerned, he can find no official fault; and this would be a work complying with the Alkali Act, and yet worse than farmers even imagine.

Some people may think we are talking loosely, and that, as it is the interest of a manufacturer to keep his acid, they may venture to assert such prodigality is impossible. This kind of argument is very common; so far as chemical works are concerned, however, it does not hold good: people do act against their own interests. Do we not know in the abstract that all evil is against the true interest of man, but it does not therefore cease?

We hope we have said enough to show that the Alkali Act is not sufficient to protect the farmers even from alkali works; and what shall we say of copper works, sending out their 100 per cent of sulphurous and sulphuric acid in clouds that dull the sky for miles; of chlorine, of nitrous gases, of sulphuretted hydrogen, and of fluorine compounds? The Alkali Act regards only one of the noxious gases; and the question may be put—Shall it be extended to more? In some places its influence can be but small, because so many other gases interfere. But, even when they do not interfere, is it not true that an escape of muriatic acid may come, and, in a few hours, destroy the labour of months? Is this just in the alkali makers? Of course, all are not to be blamed for this, nor are all believed to allow any sulphuric acid to escape, but we say it because, as a rule, the farmer has ground for complaint as well as the alkali maker. We do not, however, entirely take the farmer's side; by no means: we know of men who could not stay at a farm

when the alkali works were given up; and the greediness of human nature constrains us to doubt if the manufacturers are quite justly treated by the farmers.

"An Interested Person" asks if a scientific legal court ought not to be constituted. Trials for nuisances are generally very unsatisfactory. There is no authorised person to put down the daring assertions made by some men. We have heard one say that sulphuretted hydrogen did no harm to human beings, and the judge could not contradict. Not long ago we heard of a witness who said that the gases complained of were a mixture of sulphurous acid, chlorine, and sulphuretted hydrogen! Now, no judges are even expected to know that these gases cannot exist together, and, with one or two exceptions, barristers do not know. If a chemist happen to be present, he may get a pertinent question put, but if not very determined, he may find a difficulty, and many would rather let the case go to wreck than be put to the discomfort of asserting their knowledge amidst the unpleasant badgering of a public court. The greater number of the questions arising at a trial would be settled by men who had very simple notions of justice if only the facts were well known.

Would a scientific court do the work better? It was purposed that the Inspector should have most of the gases under his view, and should be allowed to settle questions which involved claims such as are brought to a County Court. We do not pretend to decide, and should be unwilling to lay claim in favour of scientific men to the prejudice of such an important body as men of law. We believe that it would be better for both parties if the facts of the case were probed more fully by a chemical mind. Scientific men cannot expect to adjudicate so clearly in vexed questions as the legal profession, which has struggled since civilisation began to put in order the varied activities of the human race, which yearly invents new crimes and makes room for new virtues. Perhaps "An Interested Person" may, on further consideration, think his view of this question not quite adequate.

ON SOME APPLICATIONS OF ELECTRICITY TO NAVAL AND MILITARY PURPOSES.*

By F. A. ABEL, F.R.S., For. Sec. C.S.

(Continued from p. 221).

A CLASS of electrical instruments has been created within the last three years which bids fair to supplant even these very powerful and efficient frictional machines. The instruments in question, of which different forms have been devised by Wheatstone, Wilde, Siemens, and Ladd, have received the generic name of *dynamo-electric machines*, because dynamic force becomes through their agency a direct and powerful source of electricity. In the machines of Siemens, Wheatstone, and Ladd, mechanical power is transformed into electric force without the intervention of permanent magnets. The action of the most simple form of these instruments may be described as follows:—The residual magnetism existing in an electro-magnet suffices to develop an induced current in a rapidly-revolving coil armature; this current, reacting upon the electro-magnet, determines the development of powerful magnetism in the latter by the inductive action of its insulated coils; the currents developed by the electro-magnet are consequently in their turn greatly increased in power, and react again upon the armature; and thus an immense accumulation of electric force is accomplished with great rapidity until, when that accumulation has reached the maximum attainable without detriment to

* A lecture delivered before the Royal Institution of Great Britain, March 12, 1869.

the insulation of the wire coils, a simple interrupting arrangement causes the current to be diverted from the machine to conducting wires, by whose medium it is utilised. The details of the machines vary according to the different plans adopted by the several constructors, but the above explanation applies more particularly to the machines of Messrs. Siemens and Halske, who have been the first to produce a small instrument of this class thoroughly applicable to mining purposes, and which almost equals in power the ebonite frictional electric machine. Fifty charges, arranged in simple circuit, have been repeatedly exploded, without any failures, by one of these machines; it therefore provides with certainty the power necessary for the most extensive mining or submarine operations, and is at the same time quite free from all disturbing atmospheric influences. Its mechanism is simple, and less easily susceptible of derangement than that of any magneto-electric apparatus, and as it is independent of everything but the application of manual power for the development of its action, it is far superior to the most perfect of these, independently of the fact that it surpasses them all greatly in power. For many important military and mining operations the hand dynamo-electric machines, constructed by Messrs. Siemens and Halske, are therefore unquestionably superior to all other existing apparatus which furnish electricity of tension. This class of instrument, however, shares, to some extent at any rate, one important defect of the frictional-electric machines, which is consequent upon the powerful charges of high-tension electricity sent into conducting wires by their agency. It was observed, in the earlier experiments of the Austrians with frictional electricity, that if two or more insulated wires which led to distinct mines were situated side by side, in moderately close proximity, even only for comparatively short distances, the charge sent from the machine into one of the wires, with the view of only exploding a particular mine or series, might develop in neighbouring wires, not connected with the machine, a charge of induced electricity of sufficient power to explode the mines connected with those wires. Some results obtained at Chatham, and many experiments recently instituted at Woolwich, have not only confirmed those observations in Austria, but have shown that means do not at present exist of avoiding this serious defect of powerful charges of high tension. If, therefore, it is necessary to lead separate wires from the point of operation (from the exploding instrument) to different mines or groups which it is desired to explode independently of each other, it is impossible to employ the frictional electric machine as the exploding agent without great risk of failure, even though the wires, laid upon or imbedded in earth, are separated as widely as possible, as they must unavoidably extend in proximity to each other to a distance from their points of union with the machine, which, if the latter be highly charged, may prove sufficient to determine the development of induced "exploding" currents in the wires leading to mines not intended to be fired. If the wires lead to submarine mines or torpedoes, and are therefore submerged, the unintentional explosion of mines becomes much more certain, and the frictional machine is consequently inapplicable to submarine operations in all instances where mines are arranged in separate circuits. The dynamo-electric machines share this serious defect to some extent; still, with proper experience in their use, they are not altogether inapplicable to such services as above specified. If Siemens's dynamo-electric machine be highly charged by very rapid revolutions of the armature, the inductive action of the charge will be similar in power to that exerted by the charge of the frictional machine, but, by revolving the armatures slowly, it is possible to charge the machine sufficiently to fire a mine or a small group with certainty, while the inductive action of the charge sent into the wire will not influence neighbouring wires to an extent sufficient to cause the explosion of mines connected with them.

The subject of the application of electricity to the ex-

plosion of submarine mines for purposes of defence and attack received some attention from the Russians during the Crimean war, and was practically developed in its most simple form in 1859, in the hands of the Austrian government, when a system of submarine mines, to be fired through the agency of electricity by operators on shore, was applied by Baron von Ebner to the defence of Venice, which, however, never came into practical operation. The subject of the utilisation of electricity for purposes of defence did not, however, receive serious consideration in England or other countries until some years afterwards, when the great importance of submarine mines as engines of war was demonstrated by the number of ships destroyed and injured during the war in America. Twenty-five vessels belonging to the Federal navy were destroyed and nine others injured by the explosion of torpedoes, while the Confederates lost three vessels by accidentally coming into collision with their own torpedoes, and one which was attacked by means of a torpedo and destroyed by the Federals.

Soon after the commencement of that war the attention of the English government was called to the importance of practical inquiry into the value of submarine obstructions, both passive and active, as auxiliary agents of defence, and a committee was appointed at the suggestion of Colonel Jervois, C.B., R.E., to report on the use which might be made of floating or sunken obstructions and of submarine mines, in the defence of channels, harbours, and rivers. The labours of this committee have recently terminated, and they were enabled, by the aid of systematic investigations conducted for them at Woolwich during the last four years by one of their members, Mr. Abel, and of practical experiments carried on chiefly at Chatham under the direction of another of their body, Colonel A. à'C. Fisher, C.B., R.E., to elaborate the subject of the application of electricity to submarine mines and torpedoes, to such an extent that a solid foundation of information and instruction is now available for those who may at any time have to be entrusted with the actual arrangement and employment of these important means of defence. Continental Governments have also devoted much attention to this subject, and especially the Austrian Government, for whom Baron von Ebner devised an ingenious and elaborate system of electric torpedo defence, exhibited in detail at the Paris Exhibition of 1867, which received application during the recent war, though its efficiency was not actually put to the test except in the way of experiment.

The application of electricity to the explosion of torpedoes was very limited during the American war; but arrangements for the extensive employment of that agent as the exploding power were far advanced in the hands of both the Federals and Confederates at the close of that war. It appears that only in two instances of the entire number of vessels destroyed and injured was the explosion of the torpedoes effected by electric arrangements, the others having all been exploded by mechanical agency.

The explosion of submerged charges of gunpowder by mechanical contrivances, either of a self-acting nature or to be set into action at desired periods, was accomplished as far back as 1583, during the siege of Antwerp by the Duke of Parma. The English employed self-acting torpedoes against the French ships off Rochelle in 1628, and from that period to 1854 devices of more or less ingenious and practicable character have been proposed from time to time, and even applied to some small extent in different countries, for the explosion of torpedoes either by clock-work, at fixed periods, or by coming into collision with a ship. The Russians were the first to apply self-acting mechanical torpedoes with any prospect of success, and there is little doubt that had the machines which were applied to the defence of the Baltic been of larger size (they only contained 8 or 9 lbs. of gunpowder), their presence would have proved very disastrous to some of the English ships which come into collision with and exploded them. Various mechanical devices for effecting

the explosion of torpedoes by their collision with a ship were employed by the Americans during the recent war, a few of which proved very effective. But although, in point of simplicity and cost, a system of defence by means of mechanical torpedoes possesses decided advantages over any extensive arrangements for exploding submarine mines by electric agency, their employment is attended by such considerable risk of accident to those at whose hands they receive application that, under many circumstances which are likely to occur, they become almost as great a source of danger to friend as to foe. Thus the operations of lowering and mooring torpedoes, the explosion of which depends upon the application of a blow, thrust, or pull to some portion of the machine, which is so placed and arranged as to be in a favourable position for the application of mechanical action by a passing ship, are attended with very great danger to those employed, unless some means are adopted for rendering the exploding mechanism inactive until after the torpedo has been placed in position. But the employment of a safeguard of this kind involves a considerable amount of uncertainty as to the torpedo being rendered active, by its removal after the operation of mooring is completed, because this very removal is frequently a dangerous operation. Again, when once the mechanical torpedoes have been placed in position and rendered active, they are as dangerous to friendly ships as to the enemy; consequently their employment for the defence of a particular tract of water completely closes it until the torpedoes have been exploded or removed, and their removal obviously constitutes one of the most dangerous services upon which men can be employed. Several instances have recently occurred in America of the destruction of ships in waters defended during the war by mechanical torpedoes, of which it was believed that the subsequent removal had been completely accomplished. Some improvements have recently been made in mechanical and chemical appliances of a self-acting nature for torpedoes by the employment of which the mooring arrangements can be completed with perfect safety, and the torpedoes afterwards rendered active, by the performance of a simple and safe operation when it is desired to close the defended water. But the complete exclusion of friendly vessels, and the difficulties attending the raising of the torpedoes when no longer required, still constitute formidable objections against the use of mechanical torpedoes, excepting in the case of tracts of water which are not ordinarily navigated, but the passage of which in times of war might be attempted by vessels of light draft.

The most important advantages secured by the application of electricity as the exploding agent of submarine mines and torpedoes are as follows:—They may be placed in position with absolute safety to the operators; they may be rendered active or passive at any moment from the shore; the waters which they are employed to defend are therefore never closed to friendly vessels until immediately before the approach of an enemy; they can be fixed at any depth beneath the surface (while mechanical torpedoes must be situated directly or nearly in the path of a passing ship), a circumstance which very considerably simplifies the arrangements for their application in tidal waters; lastly, electric torpedoes may, when no longer required, be removed with as much safety as attended their application.

(To be continued).

On the Estimation of the Iodine of Commerce by Volumetrical Analysis.—M. Bobierre dissolves a weighed quantity of the iodine, the true value of which has to be estimated, in a concentrated solution of iodide of potassium, the solution is diluted to 100 c.c., and is dropped into an alkaline solution of arsenious acid of known strength. Instead of using starch water, as a means of recognising the end of the reaction, the author adds a few cubic centimetres of benzol to the solution of arsenious acid, and ceases to add more of the solution of iodine as soon as the former solution becomes rose-coloured. The arsenical solution is made by weighing off 49.95 grms. of arsenious acid and 14.5 grms. of crystallised carbonate of soda, and dissolving these in 1 litre of water, representing 12.688 grms. of iodine to the litre; 10 c.c. of this solution are taken for each assay, and 4 c.c. of benzol are added.

—*J. de Pharmacie.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

May 6th, 1869.

Dr. A. W. WILLIAMSON, F.R.S., President, in the Chair.

Abstract of MR. I. LOWTHIAN BELL'S Lecture "On the Chemistry of the Blast Furnace."

(Concluded from p. 234.)

ONE duty of limestone in blast furnaces, but not the only one, is to act as a flux, by melting and separating the solid impurities of the ore. It is usually considered that the use of an excess of lime promotes the separation of sulphur, and, it may be, phosphorus.

Mention has already been made of the difficulty of drawing any general conclusions respecting the progress of the operation of smelting from an examination of analyses of the solid contents of a blast furnace. It may be also questioned whether the current of gaseous matter would have anything like a uniform composition over any horizontal section corresponding to the point where the samples were taken.

Considering the properties of carbonate of lime when exposed to heat in an atmosphere of carbonic acid, the problem of drawing, from the presence of this gas, any general influence of the chemical change going on in a furnace, becomes very intricate, if, indeed, not impossible.

This salt of lime parts with half its carbonic acid at a moderate red heat, a much higher temperature being required before the whole is expelled; the last half, more or less, will not be set free until it meets with hot carbon, when it is instantly resolved into carbonic oxide.

Caustic lime is frequently employed in the operation, but this does not simplify the enquiry, but rather the reverse. Up to a temperature of redness, I ascertained lime absorbed carbonic acid in proportion to the temperature to which it was exposed—i.e., the higher the heat the more rapid was the union; this increase went on until 19 per cent of the weight of the lime was taken up, after which a stream of the gas continued for nine hours produced no further change. On the other hand, carbonate of lime and caustic lime were subjected to a current of carbonic acid in a porcelain tube, and heated until the latter began to soften. In this case there was no absorption of carbonic acid, and, on the contrary, all the acid was drawn off from the carbonate.

So far as moderate temperatures are concerned, it was ascertained that caustic lime rapidly absorbs caustic acid from the escaping gases.

(To show the want of uniformity in composition of the gases from different depths of the furnaces, as determined by analyses, Mr. Bell exhibited diagrams, drawn to scale, in which the amounts of carbonic acid and carbonic oxide is represented by darker and lighter shades).

If the gases of a blast furnace have to furnish us with any data from which we may draw just conclusions of the nature of the chemical action going on in its interior, it appears to me little reliance can be placed on any analyses, excepting those of the gases as they escape.

It is not a difficult matter to calculate what the decomposition of furnace gases ought to be, supposing a certain quantity of coke and limestone to be consumed to the ton of iron, and the sole source of carbonic acid to be the ore by its deoxidation.

Assume the coke used to be 23.20 cwts., and the limestone 11.60 cwts. per ton of pig-iron, containing 19 cwts. of pure iron,

The coke may be taken as consisting of—

	cwts.
Pure carbon	21.80
Ash	1.40
	<hr/>
	23.20

And the limestone will consist of—	
Lime	cwts. 6.50
Carbon 1.39 } to form carbonic acid	5.10
Oxygen 3.71 }	
	11.60
The ironstone will consist of—	
Iron	cwts. 19.00
Oxygen	8.14
Earths	22.86
	50.00
The total carbon, then, to be dealt with is, in—	
Coke	cwts. 21.80
Limestone	1.39
	23.19
From which must be deducted the carbon to combine with the iron—	
	0.74
Leaving to go off as carbonic acid and carbonic oxide—	
	22.93
The total quantity of oxygen we have in the minerals, applicable to oxidising carbon, is—	
In the ore	cwts. 8.14
In the limestone	3.71
	11.85
To which may be added from the decomposition of water contained in the blast—	
	00.85
	12.70
To convert 22.93 cwts. to the state of carbonic oxide, there will be required of—	
Oxygen	cwts. 30.57
But, as applicable to these, we have in the limestone 3.71, and in the water in the blast 0.85—	
	4.56
To be derived from the atmosphere.. ..	
	26.01
26.01 atmospheric oxygen is equal to nitrogen—	
	87.07
8.14 oxygen in the ore will give of carbonic acid, generated by its action on carbonic oxide—	
	22.38
22.38 carbonic acid contains 6.10 of carbon, having 16.83 (22.93 - 6.10) to give of carbonic oxide—	
	39.27
	148.72
Supposing, then, the carbonic acid from the limestone to be decomposed, and that generated by the reduction of the ore to escape as such, the proportions in which nitrogen, carbonic acid, and carbonic oxide should be found in the escaping gases would be—	
Nitrogen	58.54
Carbonic acid	15.05
Carbonic oxide	26.41
	100.00

Analyses of the gases from a blast furnace, melting forge iron with precisely the quantity of materials named in the above calculations, show figures in a close approximation to the theoretical calculation.

We will now devote a few minutes to an examination of the blast, by means of which we obtain heat from the fuel to fuse the iron slag, and generate carbonic oxide to effect the reduction and carburisation of the metal which is the object of the process.

The effect of cold on our atmosphere being to deprive it of a considerable portion of its moisture, and to con-

tract its bulk, a cubic foot of air in winter contains, of course, less watery vapour and more oxygen than is embraced within the same space in summer.

The chief recommendation of the hot blast is the economy of fuel obtained by means of its use; and it is this attribute which possesses interest to ourselves as chemists, furnishing as it does a field of enquiry into the nature of combustion, and the appropriation of heat in blast furnaces.

If it can be shown that the progress of smelting science has been such as to reduce the consumption of coke in a furnace blown with cold air until it is within 10 or 11 cwts. per ton of iron of that used in a furnace supplied with air heated to 339° C., this is the saving we are called upon to explain.

Granting, then, for the present moment, that such saving, under the circumstances named, may be realised, it is to be remembered that the blast has the 339° of heat communicated to it by means of 5 cwts. of coal, of which, I have ascertained, more than one-half is wasted in the hot air apparatus; so that, practically, you have the heat of 2 cwts., or barely that, of fuel burnt outside the blast furnace, effecting a saving, in that burnt in its interior, of 10 to 11 cwts.

In practice, we are pretty near the truth in accepting as a fact, that an estimate of heat developed by the blast on the coke is obtained by considering its oxygen converted into carbonic oxide; for, although at the instant of its admission carbonic acid is generated, this substance is almost as rapidly converted into carbonic oxide by the action of the candescent coke. But, in the hot air stoves, the 2 cwts. of carbon are converted permanently into their highest state of oxidation; and, taking the units of heat as 2221° C. for burning carbon to carbonic oxide, and as 7900° C. for burning carbon to carbonic acid, the 2 cwts. burnt in the stove will represent 7.11 cwts. of carbon burnt in the furnace, or, say, something like 7½ cwts.

In round numbers, therefore, we may consider 7½ cwts. of our saving of 10 or 11 cwts. to be accounted for, leaving still 2½ or 3½ cwts. for further investigation.

Now, let us assume that the coke required is 40 cwts. for the ton of cold blast iron, and in the furnace, blast heated to 339° C. is suddenly introduced, which is equal in caloric power to 7½ cwts. of coke; so that, so far as a mere question of heat is concerned, something like 47½ cwts. of coke is being applied to the production of a ton of metal for which 40 cwts. will suffice.

A common yield of calcined clay ironstone is 40 per cent; so that 50 cwts. are required for a ton, to which has to be added, say 12 cwts. of limestone.

The burden, then, for 1 ton of cold blast iron would be—Coke 40 cwts., calcined ironstone 50 cwts., limestone 12 cwts; but, by the addition of the equivalent of 7½ cwts. of coke, these proportions will require a corresponding modification, and a ton of iron will be represented by heat in blast 7½ cwts., and in coke 32½ cwts., together 40 cwts.; calcined ironstone and limestone, as before, 62 cwts. together.

But what is the effect on the furnace itself by such a change in the proportion of its contents? To answer this, let us imagine a furnace with a capacity of 6,000 cubic feet.

The weights of the materials used at the Clarence Works have been carefully ascertained; and it was further determined that the weight of material in a furnace, before being lighted, was such as to cause a compression like 25 per cent; so that a furnace of 6,000 cubic feet would contain 7,500 cubic feet of materials, as measured in the charging barrows.

It therefore appears such a furnace, working on cold blast, would contain—

	tons.
Coke	56
Calcined ironstone and limestone ..	87

But, introduce the air, heated so as to reduce the coke to about 30 cwts. to the ton of iron, and the furnace would contain—

	tons.
Coke	50
Calcined ore and limestone	103
	<hr/>
	153

It would be almost impossible to ascertain to what extent these figures become modified by the action of the heat when the furnace is in blast, or what the effect of the altered proportions would be on the temperature of the ascending gases. To obtain the exact figures for this, we ought to have the specific heat of all the various materials in the furnace.

That the withdrawal of so many cubic feet of coke, and its substitution of substances nearly three times its weight, and with a mean specific heat rather higher than that of the coke itself, must permit a more perfect absorption of heat from the ascending current of gas, is obvious.

Looking at the complicated nature of the problem, it appears as if there is no alternative left but to ascertain the actual amount of heat carried off in the escaping gases, after they have performed their work in the furnace; and this, during a whole day, was done at the Cyfarthfa Works, in a hot and cold blast furnace.

The temperature of the gases was ascertained by a pyrometer, consisting simply of a copper tube, about 3 feet long and 1 inch diameter, closed at the lower end, and screwed into a Bourdon's pressure gauge.

The gases were assumed to contain according to weight—

$$9\text{CO}_2, 32\text{CO}, 59\text{N} = 100.$$

	cwts.	cwts.	cwts.
The C in CO ₂ =2.45; C in CO = 13.71. Total C ..	16.16		
The O in CO ₂ =6.55; O in CO = 18.29. Total O ..	24.84		

Total CO₂ .. 9.00. Total CO .. 32.00. Total C+O 41.00

	cwts.
Coke used per ton of iron was—	34.80
Deduct ash (5 per cent)	1.74
Deduct HO (5 per cent)	1.74
Deduct for combination with iron	0.74
	<hr/>
	4.22

Carbon in limestone	30.58
	<hr/>
	2.12

Total carbon going off in gases .. 32.70

With the composition of the gases given above, the carbon will be volatilised in the following state:—

	cwts.
CO ₂	4.96
CO	27.74
	<hr/>
	32.70

	cwts.
C 4.96, for conversion to CO ₂ , requires O ..	13.23
C 27.74, for conversion to CO, requires O ..	36.99
	<hr/>
32.70	Total O
	50.22

But in the materials themselves there is—

O in the CO ₂ of the limestone used (17.66 cwts. per ton of iron)	5.65
O in 48.43 ores (part of Fe being as FeO) ..	7.35
	<hr/>
	13.00

Having to be supplied by blast of O 37.22

The total weight of the gases would then be—

	cwts.
Carbon	32.70
Oxygen	50.22
Nitrogen, accompanying 37.22 O of blast	124.60
Water in coke 1.74; water in ore 2.19 ..	3.93
	<hr/>
	211.45

We have a total weight of gases—

	cwts.
C 4.96 + O 13.23 = CO ₂	18.19
C 27.74 + O 36.99 = CO	64.73
N	124.60
HO	3.93
	<hr/>
	211.45

The mean temperature of these gases as they left the furnace was ascertained to be 445° C.

By multiplying these weights by their various specific heat and temperature we have—

CO ₂ 18.19 × 0.212 × 445°	} 269.67
CO 64.73 × 0.288 × 445°	
N 124.60 × 0.275 × 445°	
HO 3.93 × 1.000 × 445°	

And this divided by 2221 units of heat burning C to CO, gives 12.16 cwts. of carbon, or, say, 12.76 of dry coke, as going off with the escaping gases from the cold blast furnace.

In the case of the hot blast furnace, with air heated to 320° C., the calculation stands thus:—

	cwts.
Coke used per ton of iron was	26.74
Deduct ash in coke (5 per cent)	1.33
„ HO „ „ „	1.33
„ C to combine with iron	0.74
	<hr/>
	3.40
	<hr/>
	23.34

Lime added in caustic state; hence there is no carbon to include from this source. Upon the same basis as the previous calculation, the carbon will be given in the gases as—

	cwts.
CO ₂	3.53
CO	19.81
	<hr/>
	23.34

	cwts.	cwts.
C 3.53 requires for conversion to CO ₂ of O	9.41	
C 19.81 „ „ „ CO of O	26.41	
	<hr/>	
23.34		35.82
Less O in the ores, part existing as FeO ..		8.12
		<hr/>
Leaving O to be supplied by blast		27.70

Total weight of gases will be—

	cwts.
Carbon	23.34
Oxygen	35.82
Nitrogen accompanying 27.70 O ..	92.73
Water in coke, 1.33, in ore, 1.73 ..	3.06
	<hr/>
	154.95

The mean temperature of the gases are ascertained to be 477° C., and their estimated constitution would be as follows:—

	cwts.
C 3.53 + O 9.41 = CO ₂	12.94
C 19.81 + O 26.41 = CO	46.22
N	92.73
HO	3.06
	<hr/>
	154.95

By multiplying these weights by temperature and specific heat we have—

CO ₂ 12.94 × 0.212	} × 477° = 21274
CO 46.22 × 0.288	
N 92.73 × 0.275	
HO 3.06 × 1.000	

This divided by 2221 = 9.57 carbon, or dry coke, 10.04.

	cwts.
Now, as the weight of coke per ton of iron escaping represented in heat from the cold blast furnace has been shown to be	12.76
Whereas with hot blast it is only	10.04

It follows there is escaping from the former above that going off from the latter heat equal to coke	2.72
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We have the total saving of coke as follows:—

	cwts.
1st. By use of blast heated as formerly stated	7.50
2nd. By diminution of loss of heat in the escaping gases	2.72
	10.22

which accords with the saving stated to be effected by the use of 5 cwts. of coal, of which only about 2 cwts. were really available.

Mr. Bell concluded his paper by giving in detail several other comparisons of two different furnaces carried on with cold and hot blast respectively.

The PRESIDENT, in inviting discussion, said—There is scarcely any branch of manufacture which requires so many various qualities of a rare and high kind as this particular one in which Mr. Bell is pre-eminent, and, certainly, among iron-masters there is none equal to himself in the combination of those various qualities. His scientific skill and industrial vigour have led to the construction of iron furnaces which are unsurpassed in the perfection of the operations which pertain to them. The subject is one so complicated that Mr. Bell's views will be considered exceedingly valuable in relation to it, and, certainly, all will feel interested in having so full and so masterly an exposition from himself in this matter.

Mr. SIEMENS—With regard to the saving effected by hot blast, a great deal of controversy has taken place, and I am very glad to see that Mr. Bell has really tackled the question by reducing it to figures. At first sight it appears strange that the combustion of 2 cwts. of carbon added to the blast should save 10 cwts. of coal in the blast furnace; but a little consideration, I think, would bring us already to this conclusion. If the result of combustion was carbonic acid only, then every 6 lbs. of carbon added in the shape of heat to the blast would necessarily save 14 lbs. in the furnace, that being the proportion of heat developed in burning carbon into carbonic oxide and into carbonic acid; but we find the result of combustion is not carbonic oxide but a mixture of carbonic oxide and carbonic acid. It may be assumed to be, in a furnace worked with hot blast, 1-5th carbonic acid and 4-5ths carbonic oxide; and, if we take these proportions, we shall find that the effect of 1 lb. of combustion outside the furnace would probably produce a saving of 4 lbs. inside the furnace. But why is the saving greater? If we suppose that a mixture of air, reduced ore, and carbon, comes down the furnace, and it is met by the blast, the first action is complete combustion into carbonic acid; but almost simultaneously with that action the reducing action, or the absorbing action of the carbonic acid upon carbon, takes place also. The carbonic acid is reduced to carbonic oxide, and this reduction is accompanied by a great refrigerating effect. If cold blast is used, there must be a larger proportion of carbon present with the ore, and there must be a larger surface of carbon at once exposed to the carbonic acid formed in order to effect its reduction. It has been determined practically that a cold blast furnace not only works hotter at the top, but that the proportion of carbonic acid is greater in the case of a hot than a cold blast furnace; it would, therefore, follow that the hot blast has not only produced a higher temperature at the bottom, but reduced a mixture of carbonic oxide and carbonic acid, giving larger margin of heat developed, or less refrigerating action

introduced by the formation of carbonic oxide. Perhaps Mr. Bell will be kind enough to tell us whether, on raising the temperature of the blast, the proportion of carbonic acid gas at the top of the furnace is not increased.

Mr. BELL—If you had a hot and cold blast furnace working together, irrespective of the results, with the same quantity of fuel, and the same quantity of ore, then the comparison Mr. Siemens is making would be a perfectly true one. But it happens to be the case that, upon a comparison of the Clairvale furnace, blown with a hot and with a cold blast, you find the volume of carbonic acid in the cold is considerably greater than that in the hot.

Dr. PAUL—If we compare two furnaces, one worked with cold blast, and burning fuel at the rate of 2 tons for each ton of iron produced, and a hot blast furnace, worked so that the consumption of the fuel is at the rate of only 1 ton for each ton of iron produced, we must remember that, in fact, the largest proportion altogether of the materials passing through those furnaces in both cases is the air by which the combustion is supported. Therefore, taking it for granted that in both cases the discharged gases go away at the same temperature, we have in the one blast furnace twice the amount of gaseous material passing through the furnace, and twice the quantity of heat being carried off in that escaping gas. Therefore, it is evident that the quantity going away to waste in the cold blast furnace is twice as great as in the hot blast furnace, and if we had the waste twice as much in the one case as it is in the other, it is very evident that in the hot blast furnace there must be very considerable saving.

Captain NOBLE—With respect to the ratio between carbonic acid and carbonic oxide in the waste gases, Mr. Bell has found that, within a very short time, and while apparently the furnaces are working precisely the same, there is a very great difference in their ratio. I entirely agree with what Mr. Bell has said, and I believe very little in the analyses of tunnel-head gases. The analyses of gases taken from pipes are, I believe, entirely fallacious. It is almost impossible to believe that ratios in crooked lines, like what we see on the diagram, can really exist in a furnace, and it is very evident that when we take gas from a furnace by means of a small pipe, the nature of that gas will change very much in accordance with the last substance with which the gas has come into contact—whether it be coke, for example, or whether it be ironstone. I have had occasion myself recently to make an investigation with reference to the determination of the number of units of heat produced in a furnace, and what became of them. In so doing, I have endeavoured to trace the number of units of heat that go away with the tunnel-head gases, and which are re-produced again when the tunnel-head gases are burnt, and so on. And, finally, I have worked it out in the work that is done by the engines and other means. The great variations that Mr. Bell has found in his analyses of his gases from the pipes is entirely confirmed in another way, and that is, by the amount of water vaporised. In the space of three or four hours the amount of water vaporised varied most enormously, and, if I remember right, Mr. Bell found a variation in the ratio of the carbonic acid amounting to something like 20 per cent of the whole amount. The ratio also varies much in the different furnaces.

Mr. CROSSLEY—It is certainly surprising to find that iron absorbed carbon at so early a stage in the furnace. I have passed pure carbonic oxide over pure sesquioxide of iron, and I never noticed any deposition of carbon, and I am rather afraid that, in the case of Mr. Bell, the calcined stone has not been fully calcined in the interior of the stone, and perhaps the carbon which he has obtained in the deposit is the carbon which was left in the stone. Mr. Bell has also told us something which I consider very interesting in reference to the proportion of limestone that may be used in a furnace, and he stated that the smaller the quantity of limestone used the larger the percentage of sulphur which comes off in the pig-iron. We tried some years ago some experiments in which we

used $3\frac{1}{2}$ cwts. of limestone, 7 cwts., and, I believe, 14 cwts., and we have found that the silicon and the sulphur in the iron came off in larger quantities in the iron where the smallest quantity of limestone was used, and there was a smaller proportion of metallic bases in the pig-iron produced from the smallest quantity of limestone.

Mr. COCHRANE—I shall be glad to offer a few observations on the subject of hot blast, which has been rather a pet subject with me for a great many years. I believe it is an admitted fact, that the colder oxygen is, and, of course, the more dense it is, the more intense is the action of combustion due to that oxygen, and that there is no advantage in warming it. But not so; I believe, with nitrogen, and, of course, with the mixture of atmospheric air. I think that the question of heating that mass of nitrogen has been rather overlooked in the paper; and, not only has an enormous amount to be heated in the furnace, but, I believe, a greater weight of nitrogen has to be heated for every ton of iron that is reduced. Mr. Bell has alluded to a dark appearance before the tuyere. It is notorious that this dark appearance extends, in many instances, to a long tube, right into the centre of the cold blast furnace; and that is really part and parcel of the heating apparatus which enables the blast to be delivered in the cold blast furnace at the requisite temperature for the quality of iron required. Hence it needs the element of time of combustion to be taken into account, or not the time of combustion rather, but that the material—the coke—is, in being burnt, higher in a cold blast furnace, by reason of the time required for heating all the nitrogen, and so on, than is the case in a hot blast furnace, where you start with temperature of, we will say, 1000° F., and where there is no longer any necessity for heating that blast inside the furnace. The zone of fusion is spread lower down the tuyeres, and so, *pro tanto*, you gain in height of furnace.

Mr. BELL—I will not take up many minutes in replying to the questions which have been put before us. One point raised was as to the greater volume of gases escaping from a cold blast furnace than from a hot. Well, I have not given figures on that point, because, as I stated before, I have intruded too long upon the company already. But it was, of course, impossible to ascertain the quantity of heat escaping by the gases at a certain temperature, unless I had known the quantity of gases escaping, which was a necessary element in the calculation. With respect to the observations of Mr. Crossley, with regard to the possibility of the carbon in the ironstone being the cause of the deposition of the carbon in the iron, I would remind him that a certain temperature was required. If this was deposited from the carbonic acid already existing in the iron ore, how did it happen that it never found its way there, when it was exposed merely in a blast furnace having the escaping gases going out at a temperature something like melting lead? There was an invariable connection between the temperature of the escaping gases and the appearance of this carbon. With regard to my friend Mr. Cochrane, all I can say is this, that I am not prepared to dispute whether it is better to heat the oxygen or better to heat the nitrogen. But this appears to me quite certain, that, as you look upon the blast as a mere vehicle for conveying the heat, it is a matter of perfect indifference whether the heat is carried in by 8 lbs. of oxygen or 14 lbs. of nitrogen.

I have made diagrams, not from imagination, but based upon actual analyses of the gases, to show that, at a given point, the whole of the oxygen of the blast is absorbed, and whether the blast went in hot or cold appeared to make no difference. The carbonic acid was as readily reduced to the condition of carbonic oxide in the hot blast as in the cold. The figures before you illustrate quite truly the temperature of the gases as they were coming from two furnaces and at different periods of the day; and they merely show the irregularity of action of all blast furnaces, and how impossible it is, from a few observations, to draw any general expression as to their action.

Mr. W. CHANDLER ROBERTS then gave a verbal account of, and exhibited, the apparatus for showing the expansion of palladium by hydrogenium. It consisted of a coil formed with a strip of palladium and a strip of platinum, each being 300 m.m. long, 3 m.m. wide, and 0.3 m.m. thick. This is put into a glass vessel filled with acidulated water; a plate or wire of platinum is placed near it, and the ribbon or wire connected with either pole of a battery by means of a commutator. The coil is first connected with the zinc pole of the battery, hydrogen is then thrown on the surface of the palladium, when the gas is absorbed and the spring opened. The direction of the current being reversed, oxygen is thrown on the surface of the metal, which consumes the previously occluded hydrogen and causes the index to move rapidly back to zero.

FRENCH ACADEMY OF SCIENCES.

Monday, May 10th, 1869.

SOME very interesting papers were read, but, inasmuch as some of these do not belong to chemistry, or sciences intimately connected therewith, we confine our report to what chiefly interests our readers, and, in the first place, we notice some communications by the Rev. Father SECCHI, S.J., "*On the Spectrum of the Sun's Spots.*" The learned astronomer having found that the spectrum of red coloured stars contains lines indicating the existence of carburetted hydrogen, has searched the spectrum of the sun's spots and faculæ, in order to detect therein, if possible, similar lines; and he has been successful in finding the same. We regret that we can only briefly notice this very important communication, since, without diagrams and woodcuts, it is not possible to enter fully into this subject.

M. KERIKUFF has addressed a brief note to the Academy on the subject of the scintillation of the stars. He states that, so far back as the year 1861, he had given an explanation of that phenomenon, identical with that lately set forth by M. Respighi. The note is handed over to a committee, for enquiry and report thereupon.

On behalf of M. Le Roux, M. EDMOND BECQUEREL read a communication "*On the Phenomena of Electric Light and Phosphorescence in the midst of (au sein de) Rarefied Gases.*" According to the author's statement, it is not at all necessary that an electric current should be made to pass through a gas: electricity by induction is sufficient to exhibit the phenomena. When a toothed wheel which is electrified is rapidly set in motion in close proximity to a tube containing any well-suited rarefied gas, the tube becomes illuminated and the gas phosphorescent.

M. DES CLOIZEAUX read a paper on the crystalline form, the optical properties, and chemical composition of gadolinite, a rather rare mineral, some specimens of which exhibit double refraction, while others again do not. The mineral has been found hitherto only in Norway, near Hitteroe, and in Sweden, near Ytterby. The name of the mineral is derived from M. Gadolin, a Russian chemist, who first discovered this substance, and proved it to contain yttria and glucina, as well as the oxides of cerium, of lanthanum, and silica. M. des Cloizeaux states that the mono-refracting crystals ought to be referred to the epidote. The percentage composition of the gadolinite from Ytterby is, according to Dr. Berlin's analysis, quoted by the author—Silica, 25.62; oxide of yttrium, 50.00; oxide of cerium, 7.90; protoxide of iron, 14.44; lime, 30.00; magnesia, 0.54; alumina, 0.48; potassa, 0.19; soda, 0.18. Total, 100.65.

Our readers, on referring to our report of the meeting held on the 3rd of May, will find that M. Berthelot read a memoir on the chemical equilibrium between carbon, hydrogen, and oxygen. At this meeting the said gentleman read the concluding portion of his work. The chief

fact observed is, that the decomposition of carbonic acid by the electric spark does not come to any fixed end—in other words, does not proceed beyond a certain limit—because the oxide of carbon and oxygen resulting from the decomposition of the carbonic acid have a tendency to become combined again and re-constitute carbonic acid.

M. SAINTE-CLAIRE-DEVILLE made a statement about his meteorological experiments and observations, from which he concludes that the changes of temperature are subject to periodical variations, returning regularly after 90, 30, and 10 days, due to and caused by the passage of our earth through different portions of the space of the universe. The same gentleman and M. Silbermann had a long discussion on the subject of the cause of the aurora borealis, which led, however, to no result of any importance to the general scientific public.

On behalf of M. Margueritte, M. Sainte-Claire Deville read a note setting forth the objections they have to make against the theory of M. Dubrunfaut concerning the supersaturation of sugar solutions in alcohol. The author says that Dubrunfaut has not proved by any experiment that when crystallisable sugar is dissolved in water, and alcohol added, any change should take place in the sugar itself. It is, therefore, evident that nothing else happens than the return to the solid state of a substance previously dissolved, and the crystallisation of which was impeded either by the presence of water, or some other unknown cause.

NOTICES OF BOOKS.

A Course of Six Lectures on the Chemical Changes of Carbon. By WILLIAM ODLING, M.B., F.R.S., Fullerian Professor of Chemistry, Royal Institution. Delivered before a Juvenile Auditory at the Royal Institution of Great Britain during the Christmas Holidays of 1868-69. London: Longmans, Green, and Co.

Few men who have ever devoted themselves to chemistry, forget their first attendance at a chemical lecture. The lecturer may not be profoundly learned, or even a brilliant manipulator—he may use hard words, and omit to explain them; he may totally fail in some experiments, and only partially succeed in others—it matters not; to an intelligent and imaginative boy there is a magical charm about the new world thus opened to his mind which time can never efface.

But replace the school-room by the theatre of the Royal Institution, the amateur or itinerant lecturer by Faraday, the imperfect apparatus by all the appliances which refined science can suggest; can we then wonder if the impressions so formed exercise a lasting and glorious influence over the mind of the youthful spectator?

Only those who have seen the rapt and delighted gaze of the juvenile audiences, as they followed, with intelligent appreciation, each experiment and explanation of Faraday, can fully appreciate the enormous amount of good which must arise from these lectures.

The worthy successor of Faraday, in his Chair at the Royal Institution, has so far followed in the footsteps of his predecessor, that he has continued to give lectures to the young, and with eminently successful results.

The present series of lectures on the chemical changes of carbon will be found to contain all that can be said upon the subject capable of being comprehended by a juvenile auditory; and being printed as they were taken down *verbatim* by the reporter of the CHEMICAL NEWS, they possess all the vivacity, as well as originality and clearness of style, which distinguish the eminent chemist by whom they were delivered.

A remarkable feature in these lectures is the fact that every term made use of is defined as it occurs, and the oral definition is supplemented by a clear and decisive experimental illustration.

It must not be forgotten that *Carbon*, in some respects, stands alone among the elements. Its compounds are more numerous than those of any other element, and their history by the older chemists was considered to constitute a distinct branch of the science, and called "Organic Chemistry." In the present day, the results of research have been to break down the barriers which were supposed to exist between organic and inorganic chemistry; and it has been found that a vast number of bodies, at one time supposed to be producible only by the agency of animal or vegetable life, can now be formed by the chemist from absolutely inorganic matter. The result of these discoveries has been that the phrase "Organic Chemistry" is, by the more advanced chemists, abandoned for the more accurate term, "Chemistry of the Compounds of Carbon."

While reminding our youthful readers that the chemistry of carbon includes the chemical history of all animal and vegetable substances, we cannot, we think, offer them better advice than to commence that grand study by a careful perusal of Dr. Odling's Lectures "On the Chemical Changes of Carbon."

Chemical Labels, according to the latest System of Nomenclature. London: H. K. Lewis. Price 1s.

A series of Chemical Labels, with Symbols, arranged according to the New Notation. Leeds: Harvey, Reynolds, and Co. Price 6d.

Complete Series of Photographic Labels, including Solids and Solutions, with Duplicates and Blank Labels. Leeds: Harvey, Reynolds, and Co. Price 6d.

Mawson and Swan's Book of Chemical Labels. Revised Edition. Newcastle-on-Tyne: Mawson and Swan. Price 1s.

Few things are more necessary for a chemist's laboratory than good, boldly-printed labels, and, for the student of the present day, it is almost essential to use those in which the old and new formulæ are given.

The first of these series has been very carefully compiled by Mr. Henry Matthews and Mr. C. W. Quin, whose names alone are sufficient to guarantee an expenditure of time and thought in their arrangement, which cannot fail, in a great measure, to meet the requirements of the analytical chemist. The compilers have, we think, been judicious in selecting labels for those tests and reagents only which are in constant use.

Messrs. Harvey and Reynolds's series are arranged according to the new notation, and only the new formula is given; the type is clear and distinct, and the book is well worth the moderate sum charged for it.

Photographers will do well to avail themselves of the useful and complete set of labels for photographic chemicals, which appears to contain all the solids and solutions in present use. We would, however, suggest that, in a new edition, the word *poison* should be annexed to such substances as cyanide of potassium, &c.; for, although it is not customary for wholesale houses to take this precaution, it is highly necessary for it to be observed, where poisons are in constant use; and especially for cyanide, which is used in solution for fixing positives, by young amateurs and others, who are not always the most careful with poisons.

We are glad to find that the revised edition of Mawson and Swan's labels is free from the many imperfections of the first. The labels are alphabetically arranged, with the inner margins perforated. The names and formulæ accord with the latest editions of "Fownes," "Roscoe," and "Fresenius," while, in most instances, the old names and formulæ are given in italics. The term *acid* is restricted to hydrogen salts, and the specific gravities of the strong and dilute acids as well as the proportions of acid to water are given. Labels intended for solutions of salts bear the word "solution," and the various states of tests and

reagents are appended, thus obviating the practice of using the same label for a salt, whether it contains water of crystallisation, or is in a state of fusion, or in solution. We can certainly say of this edition what we could not conscientiously say of the first, that it has been compiled with an amount of care and attention which could only be bestowed by a chemist well versed in both the old and new systems of nomenclature and notation, and fully maintains the high character the publishers have attained as manufacturers of chemical apparatus and pure chemicals.

CORRESPONDENCE.

EQUIVALENCE AND QUANTIVALENCE.

To the Editor of the Chemical News.

SIR,—I would suggest that the quantivalent discussion has not made good progress.

Mr. Orme unfairly insists that equivalent notions involve an "equivalent weight" of nitrogen in ammonia to be $\frac{1}{3}$, &c., &c.

Between the modern views of "atomicity," as cautiously put forth by Wurtz and other leading chemists, and the older views of "equivalents" there is, I moot, *no essential difference*. To both the N of ammonia is equally triatomic or trivalent.

But Mr. Attfeld takes up an entirely new position, viz.—that quantivalence is an essential quality *per se*. If it could be shown that N is equally trivalent in nitrous oxide, nitric oxide, nitric acid, the peroxide, and also in nitric acid, and similarly for other multiple combinations, then the matter would be settled.

It is true that ammonia is a leading and characteristic type of combination between N and H, but it is not exclusively such.

The ratio is—

- 1 to 2 in amidogen.
- 1 to 3 in ammonia.
- 1 to $3\frac{1}{2}$ (2 to 7) in atmonium?
- 1 to 4 in ammonium.

The atmonia? type is not well recognised, but it is becoming very prolific in the innumerable amides, ureas, ureides, &c., &c.—I am, &c.,

CHEMICUS.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the very generally expressed wishes of our friends and readers, we have endeavoured to effect arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.

Annalen der Chemie und Pharmacie, April, 1869.

The following are the original papers which appear in this number:—"On Salicyl Compounds," by Schröder and Prinzhorn.—"On Propylphycite and some Substances allied thereto," by J. G. Wolff.—"On a New Method of the Formation of Glycogollamide, and on the Constitution of Urea," by Heintz.—Second part of lengthy treatise of A. Lieben's "On the Synthesis of Alcohols by Means of Chloruretted Ether."—Reply from A. Strecker to M. Maly's criticisms on Strecker's paper "On the Identity of the so-called Abietinic Acid and Sylvinic Acid." The above papers are treatises and essays rather than papers, and are so concisely written as to be unfit for condensation.

Moniteur Scientifique, No. 297, 1869.

The Use of Bran in Brewing, Manufacture of Spirits and Starch Making.—Since bran contains from 40 to 60 per cent of its weight of starch (farine), M. Poncelet proposes to use a certain quantity of bran instead of malt or raw grain for the purposes of brewing, making spirits from grain, and the manufacture of starch. He either uses the bran as it is, or extracts the starch from it previously, and adds this substance to the materials required for the mash-tubs.

The Substitution of Alum-shale for Bone-Black in Sugar Manufacture.—M. Belin proposes to do away with the use of animal charcoal for sugar manufacturing purposes, and to substitute instead the exhausted alum-shale after it has been applied to the manufacture of alum, or sulphate of iron. 100 parts of juice from beet-root require from one to eight parts of the exhausted shale. The liquid, after having become clarified, is evaporated to 26 degrees Beaumé in contact with air without any previous filtration, and next concentrated in vacuum pans to 43 degrees. The concentrated syrup thus obtained is run into large iron tanks and left to crystallise. The only advantage gained by this process is, beside the saving of animal charcoal, the obtaining of molasses better fit for the distillery of spirits usually connected with beet-root sugar works.

Sulphurous Acid for Dissolving Bones.—It is well known that hydrochloric acid is used for the purposes of dissolving the earthy salts of bones, in order to obtain the gelatine they contain in such a state as to render that substance readily soluble in boiling water. The use, however, of hydrochloric acid is rendered rather inconvenient for this purpose, on account of the formation of chloride of calcium which interferes with the drying of the gelatine. M. Coignet, at Paris, has found that sulphurous acid answers the purpose of hydrochloric acid in this instance perfectly well. The bones are placed in cold water, and through the water a current of sulphurous acid gas is forced so long as is required to completely soften the bones, which are afterwards washed in fresh water wherein some sulphurous acid gas has been previously dissolved.

Les Mondes, May 6, 1869.

Oxyhydrogen Light.—The following description is given of the experiments which are every evening made at 44, Rue Lafitte, Paris, with the above-named light:—The burner, which is arranged to burn either pure hydrogen gas or coal gas at any pressure from 2 millimetres up to several centimetres, is constructed in the following manner:—The oxygen issues from a central opening, the hydrogen or coal gas issues from small tubular openings, not unlike those met with in the Leslie gas-burner; but instead of being as in that burner almost vertical, they are in this instance bent so as to lay almost horizontal, and thus stand with the openings opposite to each other, while the oxygen is in the centre; the flame is directed against a piece of zircon-magnesia. We further notice a circular Argand burner without any magnesia cone, and so arranged as to have the combustion of the gas supported by oxygen gas instead of by air. A modification of this burner, as regards the arrangement of the supply tubes, is made to serve for burning gas fed by oxygen, the burner being placed in strong glass globes so as to suit the purposes of lighting mines and for submarine lamps. Care has been taken by proper and suitable means to carry off the products of the combustion in each case in such manner as to insure the safe use of the apparatus.

Bulletin Mensuel de la Société Chimique de Paris, No. 4, 1869.

This number contains the following original papers:—

Discovery of a New Base.—M. Wurtz has succeeded in obtaining a new base by making chlorhydrate of glycol act upon toluidine at a temperature of from 200° to 220° C. This substance exhibits a beautifully green fluorescence, has a bitter state, is precipitated by a solution of iodine in solution of iodide of potassium. It contains H₂ less than toluidine, while for two other hydrogen atoms are substituted a vinyl and hydroxethylen group. The chloroplatinate of the base is a crystalline substance readily decomposed by heat.

Two replies, rather than papers, by Messrs. Fittig and Wurtz, to criticisms made upon their work are of no particular interest. Concluding portion of Berthelot's paper "On the Universal Method of Reducing the Hydrogen of Organic Compounds." "On the Detection of Sulphur by the Spectroscope," by M. Salet. This is a re-discovery of Mr. Barrett's researches on this subject published some years ago in the *Philosophical Magazine*.

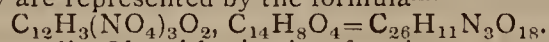
On a Substance Homologous with Borneo Camphor.—The substance known in perfumery and pharmacy as patchouli camphor is, according to recent researches of M. Gal, a substance homologous with Borneo camphor, which is represented by C₃₀H₂₈O₂. The average results of several elementary analyses of patchouli camphor gave for 100 parts:—C, 80.1; H, 12.6; the formula just quoted requires C, 80.3; H, 12.5; the vapour density of this substance taken at 324° is 8.00; patchouli camphor is solid, fuses between 54° and 55°, and boils at 296°; its specific gravity is 1.051, at a temperature of 4.5° C. The camphor is insoluble in water, readily soluble in alcohol and ether; it crystallises in hexagonal prisms. While Borneo camphor is a right-handed rotatory substance, the patchouli camphor is left-handed. When patchouli camphor is distilled with chloride of zinc at between 248° and 252° C., it yields a carbide of hydrogen, C₃₀H₂₆. The essence of patchouli is isomeric with the camphor, which is, it appears, simply formed by a molecular change.

On the Acetone of Formic Acid.—M. E. Mulder instituted the following experiment in order to prove that methylic aldehyde and acetone are identical, and must be both expressed by the formula,

H_2CO_3 . The author has submitted formate of lime to distillation, and has obtained a liquid which reduces silver salts to metal readily, and is, moreover, possessed of all the properties of Hofmann's methylic aldehyde.

On Nitroglycerine.—M. Tilberg has made some researches on this substance, making use of the nitroglycerine manufactured on the large scale at Stockholm. This material is decomposed by potassa, giving rise to the formation of nitrate of potassa and glycerine; but, at the same time, there are formed secondary products, as ammonia, cyanogen, oxalic and ulmic acids, and nitrous acid. According to the results of elementary analysis made by the author, the formula for this kind of nitroglycerine should be $\text{C}_3\text{H}_5(\text{NO}_2)_3\text{O}_3$. The substance is soluble in concentrated sulphuric acid, yielding a clear solution, and forming a sulphoconjugate which, on being combined with bases, gives crystallisable salts.

On some New Combinations of Orcine.—M. V. de Luynes observed that orcinic acid combines directly with picric acid, when that acid is mixed with water in too small a quantity to admit of its solution. On raising to the boiling point, orcinic acid is added gradually until all the picric acid has disappeared. On cooling, crystals are deposited which have the appearance and colour of bichromate of potassa. These crystals are deliquescent, soluble in water, alcohol, and ether, and decomposed by benzol, which takes up the picric acid and leaves the orcinic. They are represented by the formula—



Orcinic acid combines directly with nicotine, forming a rose-coloured solution. When previously fused orcinic acid is placed under a bell-jar filled with gaseous oxide of ethylene, the gas is absorbed, and the orcinic acid liquefies. An aqueous solution of orcinic acid dissolves rosaniline, partaking of the colour exhibited by the solutions of that substance. It would appear that orcinic acid also combines with common salt.

A New Compound of Lime and Sugar.—Messrs. Boivin and Loiseau have formed a new combination of lime and sugar which, moreover, contains carbonic acid. It is prepared in the following manner:—To 200 kilos. of syrup containing 60 per cent of crystallisable sugar, 120 kilos. of caustic lime as a thickish milk of lime are added, and next carbonic acid gas is passed through the mixture. After some time a precipitate is formed, and as soon as it makes its appearance, 20 litres of tepid lime-water are added, and the stream of carbonic acid gas is stopped. The precipitate just alluded to is the new compound, and it contains in 100 parts, 43 of sugar, 40 of lime, and 17 of carbonic acid.

Fluosilicic Acid for Sugar Refining.—It appears that M. Marix has taken in France a patent for the application of fluosilicic acid for the purifying of beet-root and other saccharine juices. The saccharine fluids are first diluted with a sufficient quantity of water to take away the viscosity of these fluids, sufficient fluosilicic acid is then added to precipitate all the potassa salts present, and next powdered chalk is added to saturate any excess of the acid. The fluid is then filtered in order to obtain a clear liquid, and this afterwards treated in the usual manner.

Bleaching Paper Pulp.—M. Gauny proposes to bleach paper pulp by means of bichromate of potassa. For 100 kilos. of pulp (supposed to be dry) he uses 50 kilos. of bichromate and 150 kilos. of hydrochloric acid, mixed with a sufficient quantity of water to make the pulp float. After twelve hours' standing, the chloride of chromium is washed out by means of clean water, and the pulp treated with a small quantity of bleaching powder to make it thoroughly white. The chloride of chromium is precipitated by means of excess of lime, and this mixture calcined in a reverberatory furnace, where it is converted into chromate of calcium.

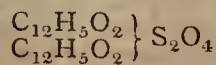
Many of the papers and short notices in this periodical appeared some years ago in the CHEMICAL NEWS. Some are eleven years old.

Journal für Praktische Chemie, No. 3, 1869.

This number contains the following original articles:—

Extraction of Zinc from its Ores by the Wet Way.—It appears that, in consequence of the scarcity of fuel, and the poverty of the main bulk of the zinc ores now found in Silesia, Prussian Empire, M. O. Jungkann has been making experiments to try to find a method of extracting from the ore the zinc it contains in a quantity of from 7 to 10 per cent, by the so-called moist way; the ore is calamine stone, or carbonate of zinc mixed with impurities, as oxide of iron, sand, alumina, lime, and magnesia. Liquid ammonia, chloride of ammonium, and hydrochloric acid were tried, but did not, for various and local reasons, answer the purpose. The author next tried chloride of calcium; this he found to answer as well with the soft residue of washing the ore schlich, containing only from 4 to 10 per cent of zinc, as with lumps containing from 20 to 27 per cent thereof; the result is that a nearly concentrated solution of chloride of calcium and boiling heat are required, but then the extraction is complete and far less expensive than with fuel, and the material obtained is readily reduced by the ordinary method of zinc smelting.

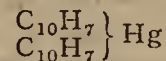
On Oxysulphobenzid.—Dr. L. Glutz has made a series of experiments which induce him to call phenol not an oxyhydrate, but an oxyhydrocarbon; this opinion is based upon the change which phenol undergoes when it is converted into oxysulphobenzid. This substance—



is obtained when 1 equivalent of phenol is heated to 160° C. with 1½ equivalents of strong sulphuric acid, the mixture poured into water, whereupon the crystalline mass thus obtained is thoroughly washed

it is next purified by dissolving it in ammonia, and precipitated from this solution by means of hydrochloric acid. The oxysulphobenzid is almost insoluble in cold water, readily soluble in alcohol and ether; it crystallises from its solution in boiling water, forming needle-like crystals; it is not affected by a high temperature, but it is difficultly sublimed; on being heated to redness it first melts, next burns off, leaving a difficultly-combustible coal. It is a weak acid, and readily soluble in the alkalis and their carbonates; it combines as well with acids, and very readily with nitric and acetic acids, but these compounds can only be formed indirectly. The author considers this substance to be an oxyacetone of the sulphuric acid series—that is to say, a derivative of a bibasic sulphuric acid, the extra radical oxygen atoms of which have been replaced by oxyphenyl.

On Mercury Naphthyl.—MM. Otto and Möries have instituted some researches on this compound, which was obtained by treating bromonaphthalin, boiling at between 277° and 278° C., with coal-tar oil boiling at from 120° to 140° C., with pasty sodium-amalgam; heat was applied, and the mixture brought to boiling and filtered while hot; on cooling, the filtrate deposited the mercury-naphthyl in small yellow crystals, which were purified by repeated re-crystallisation from solutions in benzol or sulphide of carbon. The mercury naphthyl—



exhibits small colourless prismatic crystals, not changed in the air or light, without smell, insoluble in water, sparingly soluble in alcohol, more readily soluble in warm benzol, sulphide of carbon, and best in chloroform; it fuses at 243° C., and is not quite volatile without becoming simultaneously decomposed. Heated with soda-lime, it yields mercury, naphthalin, and a hydrocarbon melting at 133° C.; the haloid hydrogen acids decompose it into naphthalin and the respective haloid salts of mercury. When moistened with alcohol, sulphuretted hydrogen does not affect it at all; fuming nitric acid converts it into nitrate of mercury and a nitro-substitute of naphthalin. Dissolved in sulphide of carbon it combines with iodine, forming biniodide of mercury-naphthyl.

Zeitschrift für Chemie, von Beilstein, No. 5, 1869.

This journal contains the following original articles:—

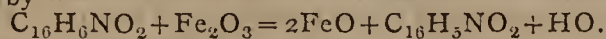
On the Decomposition of Grape Sugar in Alkaline Solution by Oxide of Copper.—It is well known that some years ago it was stated by Reichardt that gum and gummic acid ($\text{C}_6\text{H}_5\text{O}_{10}$) were the products of this reaction. M. A. Claus has endeavoured to control this statement by making a new series of researches on this subject; he reduced about 80 grms. of oxide of copper (equal to 36 grms. of sugar) at a temperature between 12° and 14° C., filtered the liquid, acidified it with acetic acid, and precipitated with acetate of lead; the precipitate thus obtained was carefully washed, next decomposed by means of sulphuretted hydrogen, the sulphide of lead removed by filtration, and the fluid somewhat evaporated at a temperature not exceeding 40° C. After removal of the HS, the fluid was divided into two equal portions, one of which was precipitated with chloride of calcium, the other with chloride of barium; the precipitates thus obtained were, after having been dried at 100° C., perfectly white, but not crystalline. The salts were analysed, and the result was, that not gummic acid, but oxymalonic acid, is formed; but this acid is no more the chief produce of this reaction than is gummic acid. The quantity of oxymalonic acid is only small; at the same time oxalic, formic, and acetic acids are generated. The quantity of oxymalonic acid obtained in free state was too small for full investigation of its properties.

Oxidation of Acetic into Oxalic Acid.—Dr. F. Lossen states that when one part of acetate of soda, one part of hydrate of soda, and two parts of permanganate of potassa are dissolved in a little water, the solution concentrated by boiling, and next brought to dryness at a temperature at which oxalic acid is not decomposed, and this heating continued until a small test-portion ceases to yield, with water, a green-coloured solution, oxalic acid can be readily proved to exist in the remaining saline mass.

On the Constituents of Peru Balsam.—M. Delafontaine has recently taken up this subject again for his experimental researches. He obtained a substance known as cinnamein, which, however, appears to be a mixture of cinnamic-benzyl ether and cinnamate of cinnamic ether; this cinnamein boils at 305° C., but is then, also, partly decomposed, leaving a resinous residue, while, when the operation is pushed rather rapidly, inflammable gases are also given off. In order to prevent any secondary decomposition, a portion of cinnamein which had not been submitted to any heat at all was saponified in the cold with an alcoholic solution of caustic potassa, and the result of this operation treated with water; this dissolved cinnamate of potassa and an oil was set free, which, by means of fractional distillation, was separated into benzyl alcohol (boiling at 205°) and cinnamic alcohol (boiling at 222°); this latter was colourless, very fluid, and the quantity obtained thereof was about half that which was obtained of benzyl alcohol. The results of the researches made by Plantamour on this subject about thirty years ago were the same. The chief mass of the balsam is therefore cinnamein, but it also contains variable quantities of other substances, among these toluol and some ethereal oils, not properly known in separate state.

On the Estimation of the Value of Indigo.—M. George Leuchs estimates the indigo-blue, the chief and only valuable constituent of the drug, in the following manner:—By means of 35 grms. of lime and 30 grms. of protosulphate of iron, 10 grms. of indigo are dissolved in 3 litres of water. In order to exclude the access of air, some petroleum was poured on the top of the fluid; (this fluid, however, was simply used as one to experiment with), and the experi-

ments lead to the result that equal portions of this solution reduce equal quantities of peroxide of iron, and that this reaction proceeds as expressed by—



In order to test any sample of indigo, 1.31 grms. thereof are so mixed with lime and sulphate of iron as to form a solution measuring 300 c.c., which should be placed in a tall cylindrical glass vessel provided with a well-fitting glass stopper. To 100 c.c. of the solution thus obtained, 66⅔ c.c. of a solution containing 1-10th of iron alum acidulated with sulphuric acid are added; the fluid so obtained is filtered, and 100 c.c. of the filtrate are taken and titrated with a solution containing 1-10th of bichromate of potassa, which is best run into the indigo containing fluid from a burette having divisions of ½ c.c., in which case every division is equal to 1 per cent of indigo-blue.

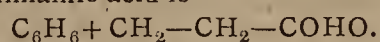
No. 6, 1869.

On Cyanphenylen.—M. W. Irelan states that, when bromophenylsulphate of potassa and cyanide of potassium are intimately mixed, and after having been placed in a glass retort submitted to destructive distillation, a white substance is sublimed at the neck of the retort. It is a compound expressed by the formula $\text{C}_8\text{H}_4\text{N}_2$; it is, in fact, cyanphenylen, a substance possessed of a pleasant aromatic odour, insoluble in warm, as well as in cold water, difficultly soluble in boiling alcohol, and pretty readily sublimed by application of heat. Boiled with strong caustic potassa, it evolves ammonia, and is changed into an acid which, by its properties and composition is terephthalic acid.

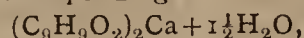
On Ethyldiphenol.—M. Burr states that when one atom of ethylenbromide, and two atoms of finely-powdered phenolide of potassium, are heated together in a sealed tube at 140°C ., bromide of potassium is formed, and an oily substance, which, on being first treated with water to separate it from the salt just alluded to, is readily soluble in ether, and, on the evaporation of that fluid having taken place, is left as a solid crystalline substance. Its formula is $\text{C}_{14}\text{H}_{14}\text{O}_2$; it is devoid of taste and smell, insoluble in water, soluble to some extent in alcohol, very readily and largely soluble in ether, fuses at 98.5°C ., and becomes solid again at 92.5°C . On being heated on platinum foil it takes fire and burns off, giving a strongly sooty flame; on being heated with nitric acid, it is converted into a deep yellow mass of needle-like crystals, which is soluble in ether, and exhibits acid properties.

On Chlorethyl-sulphuric Acid from Chlorethyl-Chloride.—M. Kind has made some experiments with the view to ascertain whether the simply-chloruretted chloride of ethyl behaves with neutral sulphite of soda in a similar manner as ethylen chloride. Pure chloruretted chloride of ethyl, the boiling point of which was ascertained to remain constantly 63°C ., was so mixed with sulphite of soda as to agree with two atoms of the latter substance against one of the former; the mixture was heated in a sealed tube for twenty-four hours consecutively at a temperature of 140°C . On opening the tube it was found that all the oily fluid had disappeared. The saline mass was first treated with dilute sulphuric acid until chlorine could not be any more detected by means of nitrate of silver, next neutralised with carbonate of soda, and, after having been evaporated to dryness, treated with alcohol; the therein soluble salt proved, on analysis, to have the exact composition of chlorethyl-sulphate of soda.

On the Synthesis of Hydrocinnamic Acid.—The formation of hydrocinnamic acid from cinnamic acid, and the fact first observed by Erlenmeyer, that the first-named acid is converted into benzoic acid on becoming oxidised, authorise the opinion that the constitutional formula of hydrocinnamic acid is—

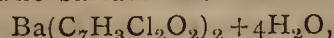


M. R. Fittig has found this to be a correct view, by discovering a new synthetical method of preparation of the hydrocinnamic acid from phenylethylchloride, a colourless liquid which boils at about 200°C . This substance was first converted into a cyanide, by means of treating the same with cyanide of potassium and alcohol; this cyanide was decomposed with caustic potassa, the residue first acidified with sulphuric acid, next shaken up with ether. On removing the ether by distillation a yellow coloured acid fluid was left, which, on being repeatedly treated with cold water, became solid; a calcium salt of this acid was made, and found to be readily soluble in hot water, from which solution it crystallised in colourless silky-looking needle-shaped crystals. On being submitted to elementary organic analysis, this calcium salt, after having been first thoroughly dried over sulphuric acid, was found to yield results corresponding to the formula—

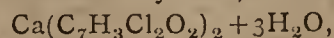


which is identical with the formula derived by M. Erlenmeyer, from his researches on hydrocinnamic acid obtained from cinnamic acid.

On the Identity of Dichlorbenzoic and Paradichlorbenzoic Acid.—Dichlorbenzoic acid is readily prepared by boiling benzoic acid with a solution of hypochlorite of lime; the crude dichlorbenzoic acid obtained is combined with baryta, and the resulting salt purified by repeated crystallisation. The acid crystallises from its aqueous solution in needle-shaped crystals, fuses at 201°C ., and sublimes without decomposition. The barium salt—



crystallises in small needle-like crystals; the calcium salt—



also appears to crystallise, and is more readily soluble in water than the baryta salt. From what has been communicated, it is clear that dichlorbenzoic and paradichlorbenzoic acid are one and the same substance,

On the Preparation of Methyl-naphthalin.—Methyl-naphthalin is prepared, according to Stacewicz, by heating together a mixture of a sulpho-salt of naphthalin, acetate of lime, and quick-lime. The distillate is dissolved in alcohol, and to the concentrated solution thus obtained water is gradually added; the substance thus separated is again dissolved in alcohol. After the evaporation of that menstruum a crystalline solid is obtained, somewhat yellow-coloured, smelling like turpentine; it is sparingly soluble in alcohol, more readily in ether; is soluble in strong sulphuric acid, yielding to it a pink colour. Its specific gravity is about 1.0; it melts at 69°C .; formula, $\text{C}_{11}\text{H}_{10}$; percentage composition, C, 93.0; H, 7.0.

On Perchloride of Benzol and its Formation from Toluol and Xylol.—MM. Beilstein and Kuhlberg have instituted a series of researches in order to prove that heptachlortoluol is nothing else than perchloride of benzol. The former substance has its formula C_7HCl_7 , and its composition in 100 parts is expressed by—C, 25.2; Cl, 74.5; H, 0.3. The latter substance is expressed by the formula C_8HCl_8 , and in 100 parts it contains—C, 25.3; Cl, 74.7. Elementary analysis could not decide anything in this instance, but the authors having followed Hugo Müller's method for the preparation of perchloride of benzol, and by diligently making a comparative study of the melting points, boiling points, and degrees of solubility, found that these properties so perfectly agreed that they feel confident both substances are identical.

On some new Compounds Derived from Mesitylen.—MM. Fittig and Hoogewerff have made a series of researches on this subject. Chlorine, it appears, acts most violently on mesitylen even when kept cold, so that the authors found great difficulty in managing the effects of this gas. They obtained monochlormesitylen, $\text{C}_6\text{H}_2\text{Cl}(\text{CH}_3)_3$, a colourless fluid as limpid as water, which boils, without undergoing decomposition, at between 204° and 206°C .; it is readily soluble in alcohol. Dichlormesitylen, $\text{C}_6\text{HCl}_2(\text{CH}_3)_3$, is a solid; it crystallises from alcohol, forming beautifully shining prisms, fuses at 59°C ., boils without decomposition at 243° , is readily soluble in warm alcohol, and, in the cold, in ether and benzol. Trichlormesitylen, $\text{C}_6\text{Cl}_3(\text{CH}_3)_3$; this substance is also a solid, and obtained when mesitylen, kept very cold, is treated with an excess of chlorine gas; it crystallises from boiling alcohol, yielding long colourless needle-shaped crystals, not very soluble in cold alcohol, better in ether; fusing, without decomposition, at 204° ; sublimable, also, without decomposition, at a higher temperature. The authors have studied and extended their researches over a series of very complex compounds obtained by the action of nitric acid upon the monochlormesitylen, and also over the derivatives from sulphomesitylenate of potassium; but, for particulars about these compounds, we beg to refer our readers to the original paper, since the authors have so concisely exposed these researches, that it is quite impossible, in justice to them and the subject, to abstract these matters.

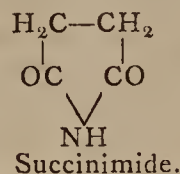
On the Specific Gravity of Chlorine.—M. E. Ludwig observes that, as a consequence of a series of determinations of the specific gravity of chlorine gas, the conclusion must be come to that this gas belongs to those kinds of vapours which only obey Mariott's law when it is at a temperature rather remote from that at which it is condensed to the fluid state. The specific gravity of chlorine at 20°C . is 2.4807; at 50°C ., 2.4783; at 100° , 2.4685; at 150° , 2.4609; at 200° , 2.4502. According to experiments made by Stas, the specific gravity of chlorine, deduced from its atomic weight, is 2.45012. M. Ludwig has repeated experiments on this subject, and found the figures obtained and just quoted to be substantially correct.

On Allyl Alcohol.—M. B. Tollens writes to the editor as follows:—I find that allyl alcohol combines, although very slowly, with H_2 , and no isopropyl alcohol is formed. When allyl alcohol is left for a considerable time in contact with a large excess of either sodium amalgam or zinc and dilute hydrochloric acid, some normal propyl alcohol is formed. When chlorine is made to act upon an aqueous solution of allyl alcohol, among other products I obtain a fluid boiling between 180° to 184° , and having its composition expressed by the formula $\text{C}_3\text{H}_6\text{Cl}_2\text{O}$; when this fluid is again treated with sodium amalgam, an alcohol is obtained. When this chloride, which happens to have the same composition as dichlorhydrin, is submitted to fractional distillation, I obtained one fluid which had its permanent boiling point at between 171° and 185°C .; the greater portion of the liquid distilled over at between 173° and 177° , a portion, however, also, at between 180° and 185°C .; the latter portion appears to contain the product derived from the action of chlorine upon allyl alcohol. Genuine dichlorhydrin boils at between 174° and 176°C .

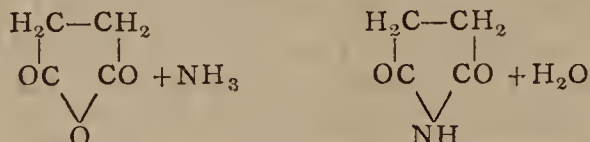
On the Products of the Destructive Distillation of Glycolic and Lactic Acids.—M. A. Krupsky records some experiments made by him on the products which glycolic acid yields when submitted to destructive distillation. 35 grms. of this acid were gradually heated, first to 120° , next to 160° , and at last to from 200° to 220°C ., the retort being placed for several days in a metallic bath made of an alloy of 2 and 1-16th parts of lead and $3\frac{1}{2}$ parts of tin, which alloy melts at 175°C . In the neck of the retort a solid substance sublimed, which could only be removed by breaking the neck of the same; on being removed, the substance was triturated in a mortar, first washed with alcohol, next with water. After repeated purifying, it was submitted to elementary analysis, and the result was—Carbon, 39.34; hydrogen, 6.69; the substance, therefore, is dioxymethylen. When lactic acid is exposed to a higher temperature, even below 200° , M. Krupsky found it to yield lactide; the most suitable temperature for the formation of this substance is between 210° to 215°C . Lactide is a solid, and exhibits beautifully-rhombic crystals when its alcoholic solution is left to spontaneous evaporation. The author's advice to those who might desire to make this substance from lactic acid, is to take 100 grms. of the acid, to place it in a glass retort, heat first for eight or ten hours in a glycerine bath at from 100° to 110°C .; next

the temperature is for thirty hours kept at from 135° to 140° C. again the temperature is raised to 170°, and at last kept at from 210° to 215° C. for about forty hours; by this method, about 20 per cent of lactide is obtained from the quantity of lactic acid originally placed in the retort.

On the Melting Point and Relative Constitution of Succinimide.—M. Erlenmeyer observes, that when he made experiments on succinic acid and succinimide, the composition of which latter substance agreed entirely with the results obtained by Fehling, he was astonished to find that the melting of succinimide was not 210° C., as stated by some authors, but 125°. M. Teuchert having, in his essay on succinamic acid, repeated the statement about the melting point of succinimide at 210° C., M. Erlenmeyer has thought it his duty to review his work and repeat his former experiments, and, moreover, obtained from M. Fehling a quantity of pure succinimide; the melting point was again found to be 125° C. As to the constitution of this substance, I prefer to express it, says the author, by a formula written in the following manner:—



Its origin from anhydrous succinic acid and ammonia is thus expressed:—



NOTES AND QUERIES.

Cryolite.—We should be glad to know of a firm who are sellers of cryolite or Greenland spar.—J. B. and Co.

Sulphate of Manganese.—What is the annual consumption of sulphate of manganese, its price per ton, and what it is principally used for, and who are the principal buyers of it?—WM. BLENCHE.

Bread for Diabetes.—Can any of your courteous readers supply me with information respecting the manufacture of the bread which is prescribed in the treatment of diabetes?—FARINA.

Alizarine.—Is MM. Graebe and Liebermann's discovery (the artificial preparation of alizarine) likely to be of any commercial value? Madder alizarine of commerce being extracted and sold profitably at less than £10 per cwt.—B. S.

Soldering Without Fire.—Information wanted concerning the brazing or hard soldering of copper without fire, and merely by the application of a preparation made for the purpose, quite independent of any galvanic arrangement.—FLUORINE.

Carbonic Acid.—Referring to the query of Mr. E. Kernan in your number of April 30th, and referred to by Dr. A. in that of May 7th, may I venture to suggest that native carbonate of barium would be a more economical source of carbonic acid than the substance named? When treated with muriatic acid, chloride of barium is formed, and the carbonic acid gas is given off very freely. If sulphuric acid be added to the barytic salt which is in solution, sulphate of barium will, of course, be precipitated, and pure hydrochloric acid recovered. The price of the carbonate of barium is 7s. per cwt.—FREDK. BRABY.

On the Characteristic Differences and Tests for the Detection of some Fatty Oils.—Dr. Sacc, of Neuchâtel.—*Castor Oil.* Nearly colourless, very viscous, faint odour; becomes more fluid on being heated; becomes bright orange coloured in contact with nitric acid. The oil does not develop much heat when brought into contact with sulphuric acid; its colour becomes thereby cinnamon-brown. When the mixture is put into water it forms a mass at first insoluble, which, however, becomes gradually decomposed, the oil floating on the top evidently having undergone little or no change at all. Acetic acid does not act upon the oil at all; soda forms an emulsion to some extent with the oil, but fails to effect this completely; alcohol dissolves some of the oil. With solution of nut-galls, a portion of the oil is converted into an emulsion; liquid ammonia is without action; with nitrate of silver a yellow colouration appears at the point of contact; chloride of gold gives rise to the formation of an emulsion, and is itself partly reduced to metal. *Linseed Oil (Raw).*—Colour deep yellow; odour acrid; when heated, its colour becomes more pale, and the oil foams strongly; with nitric acid, olive-coloured tinge. Concentrated sulphuric acid causes much disengagement of heat, and the colour of the oil becomes dark brown; the mixture swells considerably; sulphurous acid is developed as well as formic acid. The residue is insoluble in water, and gives off the smell of asphalt; acetic acid, no action; with caustic soda solution, yellow emulsion; to a small extent soluble in alcohol. With solution of nut-galls the oil becomes solidified, forming a solid yellow-coloured mass; liquid ammonia causes it to form an emulsion. No action with nitrate of silver; chloride of gold is readily and completely reduced to the metallic state when in contact with this oil. *Poppy-Seed Oil.*—Colour bright yellow; no perceptible smell; no change on being heated; no action with nitric acid. With sulphuric acid very little heat is developed, and the oil is changed into a cinnamon-brown coloured magma insoluble in water. Becomes slightly turbid with acetic acid; forms a white emulsion with soda; not soluble in

alcohol, which latter fluid floats on the oil; becomes slightly turbid with solution of nut-galls; forms a white emulsion with liquid ammonia. With solution of nitrate of silver a white emulsion is produced, only, however, at the point of contact between the oil and the solution; with chloride of gold a trace of reduction to the metallic state takes place. From these experiments we learn—(1) that nitric acid only produces a colour with ground-nut, cotton-seed, sesame-seed, castor, linseed, nut, and whale oils; (2) that sulphuric acid combines with all the oils, thereby producing compounds soluble in water in the case of olive, colza, ground-nut, cotton-seed, and sesame-seed oils; (3) that the solution of nut-galls is without action upon olive, nut, and whale oils, that all the others are made into emulsions, and that linseed oil is coagulated by the said solution; (4) that caustic soda solution forms emulsions with all the oils except that of cotton-seed, the castor oil, and nut oil; (5) that nitrate of silver becomes blackened only when in contact with colza oil; (6) that chloride of gold forms emulsions with all the oils and is in contact with all reduced to metal, excepting in the case of olive and colza oils; with the former of these and the reagent alluded to, no reaction takes place at all, and with the latter an emulsion is only formed, no reduction taking place.—*Rev. Hebd. d. Chim.*, No. 23, 1869.

MEETINGS FOR THE WEEK.

TUESDAY, 25th.—Royal Institution, 3. Professor Grant, "On Stellar Astronomy."

WEDNESDAY, 26th.—Society of Arts, 8. Geological, 8.

THURSDAY, 27th.—Royal Institution, 3. Professor Tyndall, "On Light."

— Royal, 8.30.
— Zoological, 8.30.

FRIDAY, 28th.—Royal Institution, 8. Mr. Lockyer, "On Recent Discoveries in Solar Physics."

SATURDAY, 29th.—Royal Institution, 3. Mr. Deutsch, "On Semitic Culture."

TO CORRESPONDENTS.

* * We shall feel indebted to correspondents who will forward us Reports of Local Meetings of Societies, Chemical Appointments, and any other subjects interesting to the chemical world. We regret that, owing to the increasing popularity and circulation of the CHEMICAL NEWS, and consequent pressure on our space, we are often obliged to delay the publication of long papers. To those correspondents who wish to favour our readers with Notes of New Discoveries, Descriptions of Apparatus, or Answers to Questions, we would especially recommend our Notes and Queries columns.

ERRATUM.—Page 232, column 1, line 2 from top, for "sea" read "Lea."

B.—The question was answered in our last number.

E. K.—We know of no sources of experiments on the aniline dyes than the lectures which have, from time to time, appeared on the subject in our pages.

Communications have been received from J. A. R. Newlands; W. F. K. Stock; J. Bayne; W. Blench; C. G. Williams, F.R.S.; Moy Thomas; R. G. Bennett; F. Braby; S. D. Tillman; W. C. Roberts; J. Bethell; C. W. Heaton; Dr. R. Angus Smith, F.R.S.; E. Kernan; T. A. Orme; M. A. Baines; W. H. Perkin, F.R.S.; J. H. Chesshire; W. A. Murray; D. Brown; J. Kempster; C. S. Woodrowe; T. Huson; E. H. Moss; S. Mellor; W. Baxter; T. A. Pooley; F. Stevenson; J. Yates; W. Wyles; J. Millar; Green and Co.; Eicholtz and Co.; Todd and Son; Calvert and Co. (with enclosure); G. A. Keyworth; E. Meldrum; E. K. Muspratt; A. Warner; W. Huggon; B. Winstone; and White and Co.

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On English and Foreign Alkalimetric and Chlorimetric Degrees, by John Pattinson, F.C.S. Read before the Newcastle Chemical Society.

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THE CHEMICAL NEWS.

VOL. XIX. No. 495.

ON A METHOD OF MAKING RAPID DETERMINATIONS OF FREE OXYGEN.

By P. HART.

THE apparatus required consists, in addition to an ordinary pneumatic trough, of two tubes each half-inch diameter and 16 inches long, closed at one end. One of the tubes is graduated into 50ths of a cubic inch, and the other is coated internally with phosphorus. This is effected by dropping into the tube a few pieces of phosphorus; it is then to be closed by a sound cork, and the phosphorus (melted by immersing the tube in hot water) may be spread in a thin coating over the interior by turning it round as it cools. On cooling, the cork is to be withdrawn, the tube filled with water, and a piece of india-rubber tube tied securely over the mouth. This completes the apparatus.

Modus Operandi.—Both tubes are filled with water and allowed to remain in the trough, a portion of the air to be examined is passed into the measuring tube, which is now allowed to remain for five minutes in the trough to allow it to attain the same temperature as the water. It is lifted until the water is at the same level within and without, and may then be closed by the finger, and withdrawn from the trough. The volume is easily noted. This done, it is connected by the india-rubber joint with the phosphorus tube, into which the air is allowed to flow. The whole may now be placed for half an hour in the trough, when the gas may be poured back into the measuring tube, the level once more taken, and the volume read off in the same way as before. The loss is oxygen.



a. Measuring tube.
b. India-rubber junction.
c. Phosphorus tube.

No claim is made for strict scientific accuracy in connection with this apparatus; its sole merit consists in its offering an easy and rapid means of approximately determining the free oxygen in an atmosphere. In the working of sulphuric acid chambers it has been found extremely valuable, and possibly may be found so for other technical enquiries.

REMARKS ON THE ESTIMATION OF COPPER IN ORES.

By FREDERICK FIELD, F.R.SS. L. and E.

THERE is a detailed account in the CHEMICAL NEWS (Nos. 489 and 491) of certain methods for the estimation of copper in ores, for which a premium has been awarded. The paper also contains some valuable observations by Dr. Steinbeck on the volumetric determination of copper by means of cyanide of potassium, known generally in England as Parkes's method. Dr. Steinbeck gives us the results of his experiments, which prove that, in order to estimate the metal correctly, care must be taken to avoid great excess of ammonia, or its salts, as these exercise a very disturbing influence. The Dr. has also paid considerable attention to the influence which other metals exert when in combination with the copper, and finds that lead does not interfere in any way with the valuation

of the former. He recommends the thorough washing away of the salts of zinc from the precipitated copper, previous to its solution in nitric acid, as the presence of that metal would greatly interfere in the estimation of the copper.

The writer is able most fully to confirm the above statements, from the lengthened experience he has had in South America in the estimation of copper in ores, slags, &c., many thousands of assays having been performed by Parkes's method; but there are other metals, not mentioned in Dr. Steinbeck's report, which frequently occur associated with copper, and would also be precipitated upon the zinc, together with that metal. Arsenic is, perhaps, the one most generally found; and, from many careful experiments, it has been satisfactorily proved that it exerts no influence whatever upon the correctness of the method. The same may be said of both tin and antimony.

It can be easily imagined that the metals whose oxides are soluble in ammonia would interfere with the amount of alkaline cyanide necessary to remove the colour from an ammoniacal solution of a known weight of pure copper, seeing that a portion of the cyanogen is devoted to the other metals, as well as to the copper itself. This is, of course, the case with silver, zinc, nickel, and cobalt; the two first metals forming double cupro-cyanides of great beauty and interest; and it can also be well understood that more cyanide is required in these instances than with copper *per se*.

But the writer has shown (CHEMICAL NEWS, vol. i., p. 26) that, in the case of manganese, the result is entirely different, the solution of the two metals requiring less cyanide than copper would for its decolourisation. For instance, 10 grains of electrottype copper were brought into solution with 20 grains of sulphate of manganese, and a known weight of ammonia and chloride of ammonium added. The cyanide of potassium contained in 85 divisions of the burette was found sufficient* to decolourise the liquid; while 100 divisions were requisite for ten grains of copper without manganese, treated under precisely similar circumstances.

The writer would be very glad if some one of the numerous readers of the CHEMICAL NEWS would explain this fact, which he confesses appears to him somewhat difficult.

A CHEMIST'S VIEW OF THE SEWAGE QUESTION.†

By EDWARD C. C. STANFORD, F.C.S.

OUR great object is to consider, first, how to carry away from our houses the excreta of our large population; and secondly, how to treat it so as to recover for our use its full fertilising value. The peculiar character of the material to be dealt with renders some vehicle necessary for its transport.

This vehicle may be either solid, liquid, or gaseous; and the secondary proposition depends so entirely upon the vehicle employed for the first, that I intend briefly to review these three several means of conveyance in their chemical aspect. To avoid complication in speaking of either, I shall assume the general adoption of solid vehicles, the cheapest being earth, of liquids water, and of gases air; I shall speak of the three different methods as water, earth, and air carriage, taking water first, as being now most common.

I wish to premise, however, that I regard both the above

* On the addition of Liebig's cyanide of potassium to an ammoniacal solution of the oxides of manganese and copper, a certain portion of the former is precipitated. It might be imagined that this precipitate dragged a portion of the copper with it out of solution: this is, however, not the case; the precipitates in many instances having been carefully examined for that metal.

† Read before the Glasgow Sewage Association, March 30th, 1869

propositions as essential and necessary; and take as my text Mr. F. O. Ward's celebrated formula—"the rainfall to the river, and the sewage to the soil,"—no system of sewerage is worthy our consideration which does not give back to the soil that which in our food we have taken from it; and I consider the mere ridding ourselves of a valuable fertiliser, simply on account of difficulty in dealing with it, quite beneath the enlightened spirit of our age.

For convenience of calculation, I take the population of Glasgow at 500,000, and the value of the excreta at 8s. 4d. per head per annum, or £208,333. This is the value given by Professor Way and Mr. Lawes (the highest authorities on this subject), in the third report of the Sewage Commission, and it is now generally adopted by all chemists, each person being reckoned as contributing the value of 12½ lbs. of ammonia per annum.

The total bulk of excreta, making allowance for loss, is estimated at 10 cubic feet per head per annum, and its weight 630 lbs., making an annual total of 5,000,000 cubic feet, weighing 140,625 tons; or, per day, 13,698 cubic feet, or 385 tons.

This, then, is what Glasgow has to remove. The value is 10d. per cubic foot, or 29s. 6d. per ton, and equal (Professor Way) to 16,666 tons of Peruvian guano annually. Of this amount the solids form 1-10th, and the liquids 9-10ths; or 1 cubic foot per head per annum solid, and 9 cubic feet of liquid. The solid and liquid excreta have a relative chemical value of 1 to 6, or 1s. 2d. per head for the former, and 7s. 2d. per head for the latter. The total is thus divided:—

	Tons.	s. d.	£
Annual value of solid excreta..	14,062	at 41 5 ..	29,161
„ „ liquid „ ..	126,563	„ 28 3 ..	179,172
			£208,333

The value of the daily removal is 385 „ 29 6 .. £569

Let us now see how this is proposed to be removed, and what is to be gained in the process.

WATER CARRIAGE.

Taking the amount of water used per head at 5 cubic feet daily, and the rainfall the same, we have the 10 cubic feet diluted with 3650 of water, and the annual material to be removed increased from 500,000,000 cubic feet to 1,825,000,000 cubic feet, or 140,625 tons increased to 50,920,401 tons; in other words, we require daily to pump away 140,000 tons of sewage to remove 385 tons of excreta, of which only 38½ tons is solid matter. No wonder we are called upon for lavish expenditure to carry off such a quantity as this, for even if no pumping were required, the cost for sewers must be enormous. And then does it carry it away?—and does it utilise it? Suppose an elaborate system of intercepting sewers to convey our sewage to some point several miles down the river; would that meet the evil? Let the experience of London answer this. The metropolitan sewage works are the greatest effort of this kind, and, from the difficulties overcome, are a perfect triumph of our engineering skill, reflecting the highest honour on Mr. Bazalgette; but they cost the princely sum of £4,250,000, or £180,262 per annum, the cost to be paid off in forty years by rating, at the end of which period the Thames will probably be closed as a port by their deposit, the sewer gases will have proved themselves the most deadly of enemies, and London will stand on a substratum of soil loaded with sewage from infiltration and leakage.

To show that these are not improbable speculations, I append an extract from an able article in the *Pall Mall Gazette* of February 26th, 1868, entitled "The Sanitary Dead-Lock":—

"It has now been decided that although Parliament has conferred the right of drainage into the sea and public rivers, this right can only be exercised subject to the condition that no other nuisance is thereby created. 'The notion of collecting all the sewage of a large town,' says

Vice-Chancellor Wood, in the case of Blackburn, 'and pouring it into a river without the slightest attempt to clear it of any of its grossest materials, is simply monstrous.' And, again, in the *Attorney-General v. Birmingham Town Council*, the court went as far as to declare that it would not balance the convenience of a town against the legal rights of an individual complainant—the latter must be respected. . . . The case of the metropolis differs from that of the provincial towns, but has occasioned a similar sanitary dead-lock. The main-drainage system discharges the refuse of London into the Thames at Barking and Crossness, comparatively out of the way of population. Although there is, therefore, no sanitary objection to these works, except as regards the towns below London, such as Barking, North Woolwich, Woolwich, Greenwich, Erith, &c., a serious difficulty of another kind has arisen. The mass of matter daily washed down by the sewers of London is so great that, during the few years that have elapsed since the opening of the new sewers, an enormous concentrated deposit of mud, street sweepings, and sewage refuse has accumulated in the bed of the river at Barking and Crossness, and now obstructs the navigation of the river. Last November Mr. Cave stated in the House of Commons that a ship had already stranded on one of the banks thus formed. A chart of the bed of the river at Barking, which has recently been prepared, shows that in the very centre of the channel the soundings have diminished at low water from 21 to 10 feet. . . . Whatever may be the legal aspect of the question, it is quite evident that the navigation of the Thames cannot be allowed to be obstructed even for the sake of draining the metropolis, and that legislative interference will be required if the existing Acts are at all doubtful on this point. Indeed, the whole subject demands the careful consideration of Parliament, in order to release the municipal authorities throughout England from the embarrassing position in which they are now placed. Some way must be discovered of draining our towns at a less sacrifice than is involved in the pollution of streams and blocking up of navigable rivers."

And as to the sewer gases, it appears, according to the evidence collected by the sewage commission, quite impossible to get rid of them; one of the engineers examined making this terribly suggestive answer:—"I am afraid we must let out the stink in the middle of the streets."

Now stink is not the word, for sewer gases are gases of decomposition, and carry malaria, pestilence, and death with them. Dr. Fergus has related one of many instances in which a number of houses at Leith, previously healthy, have been affected at once with gastric (or typhoid) fever, when connected with the sewers; and showing the constant infiltration of sewage into the soil, and thence into wells; he has also pointed out cases of gastric fever where the long unsuspected cause was the drinking of the water so contaminated.

Mr. Bazalgette states, that to ventilate the London sewers by air would cost £460,000 in plant, and £201,480 annually for fuel alone, exclusive of labour and other expenses; he also states that to flush them with water would cost £383,250 annually, even if the water-works could supply the quantity, which is out of the question. The water-closet system is also open to great objection—the best constructed closet is seldom perfectly free from odour; the back rush of deadly gases up the sewers when a high tide covers them, or a strong gale blows into their outlets at low tide, is of enormous force, and will rise through any closet, however well trapped.

Water is a mere carrier, and no disinfectant; its cost, also, from the great quantity required, is very considerable. Mr. Smith has stated the cost here at £40,000 per annum, and, no doubt, if general, £50,000 at least would be required to provide the water and keep up the closets.

The whole system of sewerage by water carriage is recklessly extravagant; it carries the solid and liquid excreta down to our neighbours to rot at their doors, and

it leaves us a legacy of deadly gases to remind us that our endeavour to cheat nature has signally failed. As applied to even ridding ourselves of the nuisance, it is the finest effort of "the circumlocution office," and the best illustration of "how not to do it," in our generation.

Engineers have employed an elephant to do the work of a mouse, and the burly brute has trodden down and has laid waste the country.

Then, as to its utilisation; here the system almost entirely breaks down. Notwithstanding numerous attempts, no portable manure ever has been, or ever will be, made out of sewage. The chemical value of average sewage, if it could be extracted, is 1d. per ton, taken at 4 grains ammonia to the gallon; this value is deduced from 93 analyses of Rugby sewage by Professor Way, and now generally admitted. One thousand tons are equal to 12 cwts. Peruvian guano.

Much has been said here about the solid matter deposited from sewage by standing; let it be clearly understood that it is almost valueless. At Birmingham it accumulates in large quantity, and cannot be sold at 6d. per ton. The reason of this is obvious; almost the entire manurial constituents are soluble in water; and no wonder all companies looking amongst the deposit for their dividends have failed to find them. They are exactly in the position of a ferret, watching patiently one end of a rat hole while the rat has escaped by the other.

The report of the sewage commission gives abundant evidence that even sewage irrigation only pays in certain favourable circumstances. This report is full of information, and represents an enormous amount of labour by its learned authors. They have worked hard to pick out the grain of wheat from the sack of chaff; but we must all admit that it would have saved them much trouble if we had never allowed the admixture.

Irrigation, the only method of utilising sewage, puts an amount of money value on the ground out of all proportion to the return obtained by the ratepayers. There appears no doubt that the farmer will not give ½d. per ton for it, delivered free of expense. Where gravitation and open carriers can be employed without pumping, its application is remunerative; but in no case is anything like the full money value obtained to the ratepayer. The cost of transport, where the chemical value of a product is only 1d. per ton, is far the more important item.

According to Professor Way's estimate, Glasgow would require 10,000 acres, constantly in use, at 5,000 tons sewage per acre per annum, and it would really require 15,000 acres, as one-third must be under root crop.

Now, in a damp climate like ours, what land would take this extra amount of water? and what farmer would ever dream of top-dressing his grass with manure equal to 3 tons of Peruvian guano per acre, if he had to pay the full market value for the manure? Moreover, what could be done with the grass where, as in our case, it would be impossible to make it into hay?

This system of sewage by water carriage is, however, now so general, that any means of modifying its evils may be worth our notice.

The sewer traps should all be provided with sieves of charcoal; and I propose to avoid the unsuspected dangers of the sewer gases rising in our present water-closets, to employ a double sieve of wire gauze, containing charcoal, which will slide in just under the seat, and completely close the opening, and which, by a little mechanism, can be made to slide back automatically. Or to enclose the charcoal in a small box with wire gauze sides, and simply place it in the closet. I employ, by preference, seaweed charcoal, the use of which I propose also for the filtration of town sewage, before it is allowed to pass into rivers. It is singularly allied to animal charcoal, which it excels in its porosity, its high oxidising power, and in the ease with which it admits the rapid passage of thick liquids. The thickest sewage passes through perfectly odourless and colourless. It entirely removes the organic matter from ordinary sewage, and can be used for a considerable

length of time, without change. To gain its full power, the sewage should be run into large tanks, which can be used alternately: it is here allowed to deposit for 24 hours. The filtration should be upwards, through a stratum of char, and, when the deposit rises to the char, the whole should be mixed together, and made into manure; the char mixed with the sludge would render it more easy of transport. I do not intend to imply that the char removes the manurial value of the sewage to any great extent, but it renders it innocuous.

(To be continued.)

ON SOME APPLICATIONS OF ELECTRICITY TO NAVAL AND MILITARY PURPOSES.*

By F. A. ABEL, F.R.S., For. Sec. C.S.

(Concluded from p. 243).

There are two distinct systems of applying electricity to the explosion of torpedoes. The most simple is that in which the explosion of a torpedo is made dependent upon the completion of the electric circuit by operators stationed at one or more posts of observation on shore. The particular mode of arrangement and the operation to be adopted depend in great measure upon the nature of the locality to be defended by torpedoes. If this be a river or channel, the plan of arranging and exploding torpedoes is comparatively simple, but will serve sufficiently to illustrate the general nature of this system of applying torpedoes. The mines are arranged across the river or channel in rows or lines, converging towards a station on shore, to which the conducting wires are led which are to connect each torpedo with the exploding instrument. The operator at this station has it in his power, therefore, to explode any one of the torpedoes at will, by completion of the circuit through the particular cable and the earth. Some other position on shore is selected as a second station, which commands points of view intersecting the lines of torpedoes. The operators at the two stations are placed in telegraphic communication with each other, and when a ship is observed by the operator at the second station to approach the direction of any one of the torpedoes, he will signal to the man who looks along this line of torpedoes, and the latter will complete circuit as soon as the vessel appears over the particular torpedo specified. Should the vessel alter her course in approaching the torpedoes, the operator at the observing station will inform the man at the firing station, who will alter his arrangements accordingly. Or, the man at the observing station, when he perceives a vessel to approach in a line with any of the torpedoes, places the cable of that torpedo in electric connection with the operator at the other station, and the latter will complete the circuit through the earth to the torpedo as soon as he sees that the vessel is over the first line of torpedoes. Other more or less elaborate modifications of these modes of observing and exploding have been proposed; they all depend for efficiency upon the experience, harmonious action, and constant vigilance of the operators at the exploding and observing stations. They are, moreover, entirely useless at night, and in any but clear weather. They are therefore not to be compared, in general efficiency, with self-acting electric torpedoes, which are either exploded by their collision with a ship, whereby electric circuit is completed within them, or by the vessel striking a circuit-closing arrangement moored near the surface of the water, whereupon either the torpedo, moored at some depth beneath, is instantly exploded, or a signal is furnished at the station on shore, which indicates to an operator the particular torpedo to be exploded. The object to be attained in these circuit-closing apparatus, which are so moored as to be within range of a passing

ship, is to oppose in the path of a vessel a contrivance which will not be affected by the motion of the water, but which will complete electric circuit between the conducting cable and the fuse, if struck in some particular part, or thrown into a particular position, by the advancing ship. Numerous ingenious contrivances have been proposed for this purpose and experimented with, but in only two or three instances have satisfactory results been attained, the conditions essential to success being numerous, and their combined fulfilment not easy of attainment. Simplicity of mechanism and a combination of sufficient, but not excessive, delicacy of action, with permanence during long immersion, are among the most important objects to be aimed at in the construction of these circuit-closing or signalling machines or self-acting torpedoes, which, if efficient, must contribute most importantly to the success of any arrangements for defence of a water by electric torpedoes.

It has been shown that magneto-electric instruments cannot be relied upon for submarine operations, on account of the perfect insulation of the conducting wires, joints, &c., required to ensure success with machines of that class. On the other hand, frictional machines and also dynamo-electric machines leave little to be desired as regards power to effect even the simultaneous ignition of numerous submarine mines, through cables in the insulation of which, from long-continued use, some defects exist. These instruments, therefore, are available as most efficient instruments when any extensive submarine operations have to be accomplished; but the frictional machines cannot be used as the exploding agents in connection with any system of defence by torpedoes which depends for its efficiency upon the explosion at the proper moment of only the particular torpedo over which a vessel passes, while all surrounding torpedoes still remain intact; because, for the reason which has been given, the explosion of the proper torpedo will almost invariably be attended by the accidental explosion of others which it is not desired to bring into operation. The same objection applies, at any rate to some extent, to the dynamo-electric machines. These two classes of instruments are therefore only susceptible of certain special applications in connection with submarine mines. There is, moreover, another general objection to the use of any source of electricity, the action of which is entirely dependent upon an operation to be performed at the instant that an electric discharge is required. This consists in the fact that, although the torpedoes may be self-acting, their efficiency is still dependent upon the vigilance and presence of mind of an operator on shore.

The only sources of electricity which thoroughly fulfil the conditions essential to its application with perfect confidence in connection with self-acting torpedoes, are constant voltaic batteries. By substitution of the Abel fuse for the old platinum-wire fuse, it has become possible to use batteries which were previously inapplicable to the explosion of mines, because, even when employed in considerable numbers, the quantity of electricity furnished by them is not sufficient to effect the ignition of platinum wire. Thus, a number of elements of a Daniell's battery or a sand battery, quite incapable of heating a platinum wire to redness, fires an Abel fuse with perfect certainty. The heat developed in the latter by the passage of a current from such a battery amply suffices to raise to its igniting point the readily explosive priming mixture which serves as the conductor in the fuse. Moreover, the resistance presented by the fuse is so considerable in comparison with that offered by the longest cables which are likely to be used in actual practice, that a current from a battery which possesses tension sufficient to overcome the resistance of the fuse will explode the latter with as much certainty, through cables of great length, as when it is close to the battery. A number of cells of a Bunsen's battery, sufficient to ignite a piece of platinum wire several inches in length, when close to the battery, the current of which possesses also sufficient tension to

ignite an Abel fuse, will be incapable of rendering a very short piece of thin platinum wire even moderately warm, if four or five hundred yards of ordinary conducting wire be introduced into circuit; but its power of exploding an Abel fuse will not have become at all affected. It is evident from this illustration that the necessity for greatly adding to battery-power, when mines are to be exploded through considerable lengths of wires, which exists with the use of the wire-fuses, is obviated by employing the new fuse; and thus one great objection to voltaic batteries, as exploding agents in mining operations, is set aside. Again, the sand batteries, or Daniell batteries, which are used for telegraphic purposes, and which when once charged, continue, with very little attention, in constant and good working action for several months, may now be substituted for the batteries (*e. g.*, Grove's or Bunsen's) which it was formerly necessary to employ in order to attain sufficient quantity of current, and which only continue in good action for a few hours. Sand batteries have been repeatedly employed at Woolwich for the explosion of fuses, after having been in action four or five months, with the occasional addition of a little water to compensate for evaporation.

It will be seen, from the foregoing, that constant voltaic batteries combine more thoroughly the essential qualifications of efficient exploding agents, in connection with any system of submarine defence, than all other sources of electricity at present known. They are simple of construction, inexpensive, require but little skill or labour in their production and repair, and very little attention to keep them in constant good working order for long periods. Their action is quite independent of any operation to be performed on shore at the last moment; it is only necessary to place the cables leading to the torpedoes in connection with the battery when it is desired to close a defended water,—the circuit-closing portion of the torpedo, upon being struck by a ship at any time, will then cause the instantaneous explosion of the charge. The defence by torpedoes thus becomes as effective by night as by day; moreover, the efficiency of the constant batteries is not more prejudicially affected by the existence of defects in the insulation of the cables than that of the frictional electric machines; and they may be used without incurring any risk of the unintentional explosion of torpedoes by induced currents.

Simple and powerful forms of batteries are readily extemporised, and there is no more portable, simple or economical description of exploding instrument than the ordinary volta-pile, for the construction and employment of which it is only necessary to provide a piece of hard timber, some zinc and copper sheet, an old blanket, and some vinegar and common salt. A pile, composed of 120 elements, the plates being 2½ in. diameter, is very portable, and suffices to explode a mine in single circuit, or three or four arranged in branch circuit. It will remain in good action for at least twenty-four hours, and is readily and expeditiously cleaned and re-charged. This apparatus has become a favourite exploding instrument with sailors, being easily constructed and charged anywhere, and very handy for boat operations (in connection with the employment of torpedoes as an arm of attack), in which service more delicate instruments speedily lose in efficiency. Larger piles constructed on precisely the same plan are now being used in some ships of war for the simultaneous discharge of guns, and a very small form of pile, with water only as the exciting agent, is the most convenient instrument for testing the fuses and cables of torpedoes after they are in position. It is a matter of great importance that a positive knowledge of the efficiency of a torpedo and its conducting wire should be obtained from time to time by electric tests, and there is now no difficulty in including the fuses themselves in the test. Signals may, in fact, be readily passed from one firing station to another through the fuse in a submerged torpedo, which is arranged to be fired at will from the shore.

It does not come within the scope of this discourse to enter upon a discussion of numerous important subjects connected with the actual use of electric torpedoes, or of the considerations involved in the question as to how these formidable agents of defence may be most efficiently applied, in addition to, or in the absence of, artillery defences. The object of the discourse will have been attained if it has been satisfactorily demonstrated that electrical science is destined to contribute most invaluablely to the efficiency of a country's defences.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

May 20th, 1869.

Dr. A. W. WILLIAMSON, F.R.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

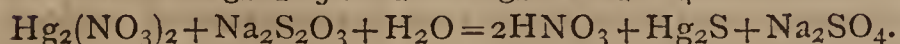
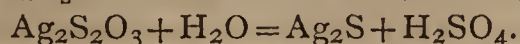
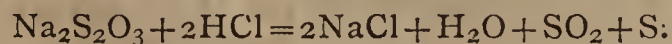
The following certificates were read:—

For the first time—Temple A. Orme, Teacher of Chemistry and Experimental Physics in University College School; W. Fletcher Barrett, Lecturer on Physical Science at the London International College.

For the second time—Wm. G. Valentin, Assistant in the Royal College of Chemistry, 126, Lancaster Road, Notting Hill; Thomas Gilham Hewlett, Surgeon, Bombay Army, Health Officer City of Bombay, Bombay; Captain A. Noble, Engineer, Elswick Ordnance Works, Newcastle; H. Stillington Grey Stephenson, B.A. Oxford, Sympsham Rectory, Weston-super-Mare.

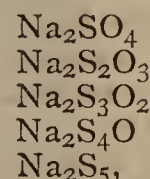
The PRESIDENT announced that, in accordance with a letter he had received from M. Dumas, the Committee had made arrangements for the inaugural Faraday discourse to be given by M. Dumas on the 17th of June, and for the banquet to take place on the 18th.

The SECRETARY then read a short paper by Dr. Schorlemmer, "*On the Constitution of Hyposulphurous Acid.*" The author referred to the experiments of Dr. Dupré, and the views lately expressed by Dr. Odling, which seemed to be supported by Rose, who states that no hyposulphite is capable of existing which does not contain at least one atom of hydrogen, and proposes to reduce the molecular weight of hyposulphurous acid to one-half. The author thought that it could not be generally known that Rose's statement was incorrect. Pape* found all the hydrogen present in the form of water of crystallisation, which, with care, could be expelled without the salt being decomposed; but the last portion of the water is driven off at a temperature only a few degrees below that at which decomposition begins. By heating the sodium, potassium, and barium salts to 215° C., they can be obtained anhydrous, while at 5° higher they decompose. The lead-salt is anhydrous at 100°, but at a few degrees higher it blackens. In many reactions, the molecule of hyposulphurous acid split up in such a way that the atom of sulphur previously contained in the sulphur dioxide remained in the oxidised state, whilst the other atom separated as free sulphur, or a sulphide—



The author, therefore, thought that the old formula, proposed by Dr. Odling fourteen years ago, must be retained for hyposulphurous acid, and that it must be considered as sulphuric acid, in which one atom of oxygen had been replaced by sulphur.

DR. ODLING referred to the discussion which followed the paper by Professor Stokes, "On a Certain Reaction of Quinine," when, in speaking of the non-fluorescence of the hyposulphite, he ventured to say that it might be that, after all, the compounds of hyposulphurous acid were not really oxygen salts, but that they were, instead, halogen salts; and, in favour of that view, he had quoted the observation of Rose, but he was not aware that this observation had been refuted. He (Dr. Odling) would like to call to mind the different views put forward with regard to the hyposulphites. Having regard to empiric formulæ only, such a salt as sulphate of soda is represented as Na_2SO_4 . The pentasulphide of sodium has the formula Na_2S_5 , so the S_5 might be taken to correspond with the S and the O_4 . The next salt in the list would be the intermediate one, $\text{Na}_2\text{S}_2\text{O}_3$, the ordinary mode of expressing hyposulphite of soda. In Sir Robert Kane's "Manual of Chemistry," a salt was described having the composition $\text{Na}_2\text{S}_3\text{O}_2$, and it was said that this salt crystallised with the same number of atoms of water of crystallisation as the hyposulphite, and was isomorphous with it. Then there only wanted the intermediate salt, $\text{Na}_2\text{S}_4\text{O}$, of which he (Dr. Odling) had never heard; but, admitting the existence of the salt described by Sir Robert Kane, and accepting the other formulæ, they would have a complete series, as follows:—



a series which seemed natural and likely to exist. If they oxidised sulphite of soda by any means, it became Na_2SO_4 ; and, if instead of oxidising it, they sulphurised it, it at once became $\text{Na}_2\text{S}_2\text{O}_3$; there was, therefore, an analogy in ultimate formulæ, and also an analogy in the particular mode of formation. Professor Kolbe had succeeded in making formic acid by reducing carbonic acid with sodium, thus: $\text{H}_2\text{CO}_3 + \text{Na}_2$; and there was produced in this way formate of soda, $\text{NaHCO}_2 + \text{NaHO}$, which remained combined with the excess of carbonic acid. This reaction was, at first sight, very similar to the ordinary reaction by which a hyposulphite was obtained by the action of sulphurous acid. The hyposulphite could be obtained very readily by dissolving zinc or iron in sulphurous acid, but they would use sodium, as before, and they obtained a result which is capable of being expressed thus: $\text{H}_2\text{SO}_3 + \text{Na}_2 = \text{NaHSO}_2 + \text{NaHO}$, which remains combined with the excess of sulphurous acid employed. This fact had led Dr. Dupré to form the opinion that carbonic and sulphuric acids were the analogues of each other. He (Dr. Dupré) made several experiments by acting upon carbonates with carbon, and the result of these experiments led him to believe that he actually formed formic acid. But the experiments, as Dr. Dupré acknowledged, could not be considered as altogether conclusive. With regard to formic acid, all experimental evidence tended to show that they had the carbon united with hydrogen and with oxygen, and also with oxygen already combined with hydrogen. But if they were right in saying that sulphurous acid was not an oxygen acid, the formic acid would be represented by $\text{H}(\text{HO})\text{CO}$, and the hyposulphurous acid by HHSO_2 , in which both of the hydrogen atoms are directly combined with sulphur. He (Dr. Odling) did not see that they were obliged to retain the old formula; the question was still an open one, and he thought the facts brought forward by Mr. Schorlemmer were as explicable to the new as to the old views.

The speaker then referred to the reactions which Mr. Schorlemmer gave, both of which, he thought, could be applied to the new way with as much or more ease than to the old. In speaking about the atom of water, Dr. Odling said that if they represented hyposulphite of soda according to the old-fashioned view, they had $\text{Na}_2\text{S}_2\text{O}_3\text{H}_2\text{O}$; but he preferred to write it 2NaHSO_2 . The

* Poggendorff's Annalen, cxvii., 408.

salt retained its atom of water with great firmness. It required a heat of 215° to drive off that atom of water from it: soda, silver, and baryta salts also required this unusually high temperature. This did not prove that the atom of water was different from water of crystallisation, but it was in favour of that view. He had said that it was impossible to drive off this atom of water, but, corrected by Mr. Schorlemmer, he would say simply that it was difficult.

Dr. Odling concluded by saying that it was a question on which he retained his mind quite open to bend in either direction as fresh facts arose, but, at the present moment, he did not think there were sufficient facts to enable them to absolutely decide the question, either one way or the other.

The PRESIDENT, in proposing a vote of thanks to Mr. Schorlemmer and Dr. Odling, thought there were two or three points brought forward by Mr. Schorlemmer which were entitled to some weight. First there was the tendency of hyposulphurous acid to form double salts of silver, sodium, &c. Among the characteristics of bibasic acids, that was one of the most conclusive, as a rule, and he (the President) thought it should weigh in Dr. Odling's mind as an argument in favour of the bigger formula. In reference to the decomposition into sulphur and sulphuric acid, it occurred to him whether there was not a difference in degree between believing that to occur by the splitting of the molecule, and believing it to occur by an action of the two molecules. There were cases which pointed to the greater facility for assuming that the result was an action in one molecule, than that it was an action of two molecules one upon another.

Mr. F. FIELD, F.R.S., then submitted a specimen of, and read a note on, sulphate of alumina from Iquique, Peru.

The following is the analysis, after deducting small quantities of chloride of sodium, oxide of iron, and silica:—

Sulphuric acid	35.56
Alumina	15.88
Water	48.56
	100.00

Corresponding to the formula $\text{Al}_2\text{O}_3, 3\text{SO}_3 + \text{HO}$, which requires—

Sulphuric acid	35.93
Alumina	15.57
Water	48.50
	100.00

Mr. W. H. PERKIN, F.R.S., then read a note "On Regnault's Chlorinated Chloride of Methyl," of which the following is a condensed abstract.

Last year the author read a paper before the British Association "On the Chloride of Methylene obtained by the Action of Nascent Hydrogen on Chloroform," which was afterwards published in this journal (CHEMICAL NEWS, vol. xviii., p. 56). The chloride of methylene obtained from chloroform was found to boil at about 41° C., the same temperature as that at which Butlerow's chloride of methylene boils. As Regnault gives the boiling point of chlorinated chloride of methyl much lower, namely, 30.5° , the author had made a fresh examination of the substance, to see if it were an isomer of chloride of methylene. After preparing a quantity of this substance, it was found to have a boiling point of between 40° and 42° C., and apparently to be identical with the chloride of methylene from chloroform. The author, however, has not yet completed its examination. Its composition was determined by its analysis and vapour density.

The PRESIDENT, in thanking Mr. Perkin for his communication, remarked that the experiments were strictly allied to a theoretical question now at issue amongst chemists, viz., that atoms had got bonds to them which were supposed to have different properties, and, accordingly, yielded different products.

DR. HUGO MULLER stated that he had made some experiments with the view of finding out a good method for

producing chloride of methylene; however, he found that at the best it was a long and tedious operation. The best result he obtained by simply dissolving the chloroform in alcohol, and adding hydrochloric acid and zinc with a few drops of platinum chloride. The whole is warmed slightly, in order to distil off the chloride of methylene as soon as it is formed, otherwise it is further acted upon and lost. He was trying some experiments with the object of obtaining bromide of methylene from bromoform, but the difficulty of obtaining the latter in quantity prevented him from going on with the experiment. He would be glad to hear of a practicable method for obtaining bromoform.

DR. MILLS said it might easily be obtained by treating dicitrates with an excess of bromine. He had obtained a large quantity in that way.

DR. MULLER had got, on the contrary, very unsatisfactory results with this method. The yield was very small in proportion to the citric acid used.

MR. BASSETT had prepared, or attempted to prepare, bromoform in the way described by Dr. Mills, but he also found that the yield was exceedingly small—a very poor product.

Mr. PERKIN mentioned that he was at present engaged in an investigation of Bunsen's gaseous bromide of methyl.

The meeting was adjourned to the 3rd of June.

PHARMACEUTICAL SOCIETY.

Adjourned Meeting, Wednesday, May 5th, 1869.

H. SUGDEN EVANS, Esq., Vice-President, in the Chair.

MR. CARTEIGHE recommenced the discussion of the subject introduced by Professor Redwood at the previous meeting. He did not agree with the most important practical suggestion made by Professor Redwood, viz., that in which he proposed to bend and modify the existing system of weights and measures, so as to gradually merge the one system into the other; there were great objections to such a process of bending.

The *tetram* or 4 gramme weight (one of the integers proposed by Professor Redwood) might be divided into tenths or into halves, quarters, &c, but they could not, as upholders of the decimal system, sanction the recognition of the octavial system involved in the latter. He did not think it would be easier to remember that the *tetram* was equal to one dram, and hence to four grammes, than to recognise the value of four grammes as such. He would rather suggest that a knowledge of the decimal system should be required by the Board of Examiners, and a book might be compiled as an addition to the British Pharmacopœia. The Pharmaceutical Society might also assist provincial societies in procuring complete sets of models illustrating the weights and measures of the metric system, so that anyone might handle and become practically acquainted with them. It would be hopeless to expect that much could be done in a short space of time. What they wanted for the present was a plan calculated to familiarise educated men of business with the metric system.

DR. REDWOOD read a letter from Mr. F. Lowe, of Liverpool, who advocated the octavial system.

DR. ATTFIELD considered there were immense advantages in a duodecimal over a decimal system, and an octavial was better than either, but as the world's system was a decimal one, ours should be so likewise.

MR. BOTTLE, believing the system must ultimately be adopted, urged upon young men the necessity of making it an early study.

MR. HASELDEN thought the system must be adopted some day, and looked to young men to make a study of it. He agreed with Mr. Carteighe in his proposal of an addition or supplement to the pharmacopœia. He would not like to see the metric equivalents added to the

pharmacopœia itself, side by side with our own. He considered the adoption of the French weighing practice, would be impeded by the aversion of the medical profession to making any change of the kind.

THE CHAIRMAN saw no great difficulties in the way. Mr. Carteighe had referred to the fact that the Board of Examiners would require a familiarity with the metric system. He considered that the Society should procure a perfect set of weight and measures for their own museum previous to assisting provincial societies, as proposed by Mr. Carteighe.

Mr. MARTINDALE thought there would be some difficulty in applying the system to dispensing, and in approximating metric weights and measures with the usual doses. He always found that medical students were taught the metric system in the laboratories at hospitals, and had subsequent difficulty in appreciating the value of grains, drachms, &c. He thought an octavial system was an impossibility.

Dr. REDWOOD thought the great defect of the present system was, that there were no integers between the grain and the ounce, and no relation between them. This had become so evident in compiling the pharmacopœia, that our present system could only be regarded as a temporary expediency. He confessed that he did not consider the metric system perfect, but he was somewhat surprised to hear he had been accustomed to condemn the system. A fault of the metric system was, that its integers had not been chosen because it was the best, but on theoretical ground; if our yard had been taken it would have been more convenient; our system is founded on experience, the metric on theory. The defects in our system must, however, be remedied, and the metric system seems to be the one generally adopted. We were the only advanced nation who had not adopted it; if we did so, it would soon become the international system. He (Dr. Redwood) thought that the difficulty would be in acquiring a knowledge of the value of its integers; to surmount this difficulty was the object of his proposals. Looking at a set of models in a museum would not suffice. He would like to have the weights marked on coin, the measures on postage stamps, &c., so as to associate the integers with objects with which we are familiar. He agreed with the proposal to enforce a knowledge of the system at the examinations, but he would only accede to the proposal to introduce weights and measures into the pharmacopœia on the condition that they were the exact equivalents. He would prefer a supplement.

Mineral Caoutchouc.—Recent communications from Adelaide, South Australia, have made known the discovery in the southern portion of the colony of a remarkable carboniferous substance, which hitherto has only been found in small quantity in the coal strata of Derbyshire, (England). It is a mineral caoutchouc, so called from its general appearance and elasticity. In Australia it is found on the surface of the sandy soil, through which it would appear to exude from beneath, as, burnt off occasionally by the bush fires, it is again found after the winter season, occurring in quantity and of varying thickness. Analysis proves it to yield 82 per cent or more of a pure hydrocarbon oil; its value for the manufacture of gas there will be great, and it is also believed to be applicable to the making of certain dyes. The discovery is also important from its indication of the existence of oils or other carboniferous deposits. This material, known in mineralogy as elaterite, is also found in a coal pit at Montrelais, near Nantes, France, at Neufchâtel, and on the island of Zante. According to the analyses of the late Professor Johnston, of Durham University, it is a hydrocarbon containing from 83.7 to 85.5 per cent of carbon, and from 12.5 to 13.28 per cent of hydrogen. The variety found in Derbyshire (near Castleton) has a specific gravity varying between 0.9053 to 1.233; the substance is highly inflammable, its colour blackish brown, its lustre resinous.—*Mining Journal*.

LABORATORY NOTES.

LABORATORY PUMP.

To the Editor of the Chemical News.

SIR,—As you published some weeks ago an account of Professor Bunsen's valuable filter pump, I may take the opportunity of describing a simple form of this pump which has been fitted up in my laboratory by Mr. Stephen Yeates, of Dublin.

The accompanying diagram shows the essential parts of the pump. A is a tube of tin, about eight inches long, and of nearly one inch internal diameter; within three inches of one end the tube B is soldered. The diameter of this tube should be about $\frac{3}{8}$ of an inch. The end of the wide tube most distant from B is now contracted so as to form a portion of a cone, and D then soldered in. A small tube, C, is now selected, one extremity of which enters, but must not at all close, the cone formed by the junction of A and D; and this point its orifice is contracted, so as not to exceed $\frac{1}{8}$ of an inch in diameter. It is then soldered, as shown, into the upper end of A. The whole arrangement is fitted to a board by the straps, S, S.

The tube, C, is connected with the vessel to be exhausted of air. B is the delivery pipe for water, obtained from a cistern or from the street main; the supply should admit of regulation by means of a stop-cock placed in the course of B. In order to obtain the maximum exhaustion with the pump, the length of D should be about thirty-three feet, but a fall of twenty feet I find to be more than sufficient for ordinary water. As this form of Bunsen's pump can be constructed by any intelligent plumber for a few shillings, no chemist need be deterred, either on account of expense or trouble, from fitting his laboratory with the new apparatus.

I have had the pump in operation in my laboratory for about two months, and gladly bear testimony to the great practical value of Professor Bunsen's admirable arrangement.—I am, &c.,

J. EMERSON REYNOLDS.

Laboratory, Royal Dublin Society,
Kildare Street, Dublin,
April 26th, 1869.

CORRESPONDENCE.

ALKALI WORKS.

To the Editor of the Chemical News.

SIR,—In my letter on "Alkali Works," which you kindly published on the 14th inst., I did not explain my ideas very fully for fear of intruding too far upon your valuable space, but after your remarks in last week's CHEMICAL NEWS (and for which I heartily thank you), I request your indulgence while I make a few supplementary notes.

Alkali Works are now generally conducted by men with considerable scientific and practical knowledge, and much care and attention is applied in order to obtain in all cases

the full produce, *i.e.*, as near the theoretical as possible, from all materials, whether solids or gases, and as this can be and is accomplished without any appreciable loss, I assumed and worked upon this assumption when I made my remarks, that no gas did or was liable to escape, except muriatic acid, and as this was under the supervision of an inspector appointed for the purpose, I considered that he was the one to prosecute if such was necessary.

To expect no odour whatever from a chemical works is too much, as it is, for instance, impossible to run still liquor off without a slight smell; but any constant escape of sulphuric or nitrous gas is quite unnecessary, and in such cases by all means let farmers and others have some means of getting redress for damage done. But, again, care must be taken that a system of *persecution* is not resorted to; and without a Court is formed for the trial of these cases, which can sift and understand the *scientific defence* of the defendants, such a state of things will result, as, for instance, I see before me a chemical works surrounded by a few other works, not alkali, but for all that emitting acid gases (glass, and other works). These are situated in an agricultural district, and, consequently, the people about there are more sensitive at their nasal members. The alkali works may have got an hereditary bad name, but no gas is allowed to escape now, yet the representatives of agriculture in that neighbourhood would, in case they saw their crops injured by gases, at once complain of the alkali works and never suspect the glass works. The reason of this is, that the uninitiated, in passing the former works, no doubt will smell an odour, while, in passing the latter, they will not smell any, and they at once, in their ignorance, put down as a fact, that the alkali is the guilty work. They do not know that, if an alkali work is properly conducted, no gas, in such a quantity as to do harm to agriculture, is allowed to escape, and that the mere puff or smell they experience in passing is quite unavoidable (as coming off, say, still liquor when being run off), but, at the same time, quite harmless, although it does go direct and affect their smelling power. Again, in their ignorance, they are not aware that other works, such as glass, are allowed to evolve *streams* of gas from their chimnies, which, instead of making itself known to every passer-by, goes, or rather is blown quietly, but in an unremitting stream, on to the adjoining fields. If a case of this sort was brought before a county court, as at present constituted, the verdict would go against the alkali manufacturer, because the judge, not understanding the chemical defence, would take the same view of the case as the farmer. I beg to ask if this state of things is fair?

For my part, I do not by any means wish to deprive farmers and others from complaining, but, knowing as I do the care that is taken by some people to prevent, and how unnecessary it is to allow gases to escape, I only wish that justice may be done to those who, perfectly innocent, may yet be so unfortunate as to be blamed for gases allowed to escape from contiguous works, unsuspected, perhaps, simply because they are *not* alkali works.—I am, &c.,

AN INTERESTED PERSON.

MISCELLANEOUS.

A Curious Laboratory.—We read in the *Lancet* that M. Sainte-Claire Déville, in connection with his scheme for substituting the mineral oils for coal as fuel in the French fleet, has undertaken a series of experiments, in which he will study the effects of pressure on various phenomena, and especially the causes of light in flame, of combustion, &c. In order to pursue these researches, it has been thought necessary to construct a large iron laboratory, capable of receiving the experimenter with all his apparatus, and which may be subjected to an extraordinary atmospheric pressure by means of suitable pumping apparatus. This iron safe has the form of a vast cylinder, surmounted by two chimneys, one serving to connect the pressure pumps, and the other to admit the operator and his apparatus. The experiments will be conducted by M. Sainte-Claire Déville and some other *savants*, and

will involve a certain degree of danger. No doubt of this latter assertion; *queritur*, how their lungs and brain will feel under increased atmospheric pressure.

Ozonisation of Hydrocarbon Oils.—M. Grotowsky, of Halle on the Saale, has made known some interesting facts on a new property of various hydrocarbon oils, which he has discovered. Exposing various kinds of oils in glass flasks to the rays of the sun for a period of three months, he found invariably that they absorbed oxygen and converted it into ozone. The air was ozonised even in well-corked vessels, the effect being, however, to some degree dependent upon the colour of the glass. The respective results were noted after the lapse of three months. American kerosene, from petroleum which had been exposed to light in white uncovered glass balloons, had become so strongly ozonised that it scarcely burned. The originally bluish white oil had assumed a vivid yellow colour, and the specific gravity was found to have increased 0.005. American kerosene, which had been kept in the dark for three months, did not show any ozone at all, and burned satisfactorily. The oils were exposed from April to July, 1868; those which had become strongly ozonised had also suffered a distinct change in odour, and the corks were bleached as if attacked by chlorine, while the other oils had remained unchanged in these particulars. These results are fully confirmed by the experience of the consumers as well as of the dealers in these oils, who all avoid obtaining "old oils" as they call them. It appears that re-distillation, with quick-lime and clean iron nails, restores the oils to their original state and properties.—*Engineer*.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we are endeavouring to effect arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will therefore be equivalent to an English edition of the "*Fahresberichte*," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.

Neues Jahrbuch für Pharmacie redigirt, von Dr. Vorwerk, No. 3, 1869.

The present number of this periodical contains the following original papers:—

"Soluble Saccharate of Oxide of Iron as Antidote against Arsenical Poisoning," by Dr. H. Köhler. This is a paper containing the description of a series of experiments made upon living animals.—"*Characteristics of the Akazga Plant, and the Structure of its Wood, as compared with that of the Strychnos nuxvomica*," Dr. R. Fraser. A botanical essay.

The remainder of the pages of this number of the periodical are filled with short abstracts taken from various periodicals published in England, France, and Germany; the greater portion interesting to our readers has been already published in these pages, we therefore confine our communication to the following:—

Analysis of Crude Cream of Tartar, Argol.—One gramme of this substance, taken from a thoroughly well mixed large average sample, previously powdered, is weighed into a tared porcelain crucible; the crucible and contents are heated to redness, and kept ignited until the contents are quietly in igneous fusion; let the weight of the residue found after cooling be called *p*. The crucible and contents are next boiled in distilled water, the fluid separated by decantation from the sediment is set aside, and the sediment washed until the wash-water no longer turns red litmus blue; the insoluble residue is dried at first on a water- and next on a sand-bath. After its weight has been ascertained, it should be called *r*; *p - r* is equal to the soluble portion of the ash which represents the carbonate of potassa. When the result of *p - r*, expressed in grammes, is multiplied by 271, the percentage of pure bitartrate of potassa is obtained contained in the sample of crude argol submitted to experiment; when the result of *p - r* is multiplied by 216, the percentage of crystallised tartaric acid is obtained.

Instability of the Solutions of Alkaloids.—A solution of 1 grm. of sulphate of quinine, 50 centigrams of tartaric acid, and 20 grms. of water, was tested, after having been standing in a stoppered bottle for twenty months. It contained 1.05 grms. of the saline constituents, instead of 1.40 grms., as when first prepared; it lost, therefore, 25 per cent. It appears, from communications received from various parties on this subject, that the same is observed to take place with most other alkaloids applied in pharmacy, and such solutions should not, therefore, be prepared for use in too large a quantity at the time.

Method of taking away the Bitter Taste of Epsom Salts.—When, in a solution of 30 grms. of this salt in 300 grms. of water, 10 grms. of roasted and ground coffee is boiled, and the fluid filtered, the bitter taste of the salt is entirely taken away, and the fluid pleasant to take.

Bulletin de l'Académie Impériale des Sciences de St. Petersburg,
T. xiii., No. 4.

This paper does not contain any communications which are of any value for our purpose; most of the communications do not refer to exact sciences, and those which do, bear upon physiology, comparative anatomy, and crystallography.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 136, April 15, 1869.

The following are original papers:—
"Velocity of the Psychical Functions of the Brain," by Prof. F. C. Donders.

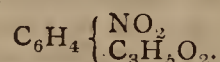
Adhesion of Hydrogen to Metals.—M. A. De la Rive.—The author, referring to a paper published by him in 1843, has now repeated some experiments, in order to prove that the pressure of the air, by facilitating the adhesion of hydrogen to metals, may become an impediment to the continuation of some chemical reactions, which, on being first called into play, are not affected by this cause.

As regards the remaining papers in this periodical, as far as they belong to chemistry, we have already published their contents; the said papers not being original communications, but abstracts from works and periodicals published in various countries.

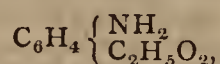
Zeitschrift für Chemie, von Beilstein and others.

The seventh number of this periodical for the present year contains the following original papers, some of which are very lengthy, and can, therefore, be only briefly noticed:—

Synthesis of Hydroparacoumaric Acid.—MM. Glaser and Buchanan.—They have essayed to substitute, for a hydrogen atom in the benzol nucleus of phenylpropionic acid, hydroxyl, in the radical C_6H_5 of the acid just alluded to; this they have done by first preparing the amido acid of the nitrophenyl-propionic acid, next converting that amido acid into the diazo combination, and, lastly, by decomposing that compound, by boiling it with water. They thus obtained paroxyphenyl-propionic acid, which, on being tested, proved to be identical with hydroparacoumaric acid. In the course of their researches, the authors have met with a great many new compounds, among which the nitrophenyl-propionic acid—



This is a solid substance, crystallises, exhibiting pale yellow crystals, difficultly soluble in cold, more readily in warm water, and very easily in alcohol and ether, and fuses at $153^\circ C.$; this acid forms readily soluble salts, which, however, crystallise difficultly. Hydrocabostyrol is also a solid substance; its formula is C_9H_9NO , fuses at $160^\circ C.$, and can be distilled over at a higher temperature without decomposition. Amidophenyl-propionic acid—



Again a solid substance, crystallising, and then exhibiting beautifully-quadrilateral prisms fusing at $131^\circ C.$; this substance forms, with acids, divers crystalline compounds. The other compounds we only briefly name, are the chloride of the diazophenyl-propionic acid, the oxyphenyl-propionic acid, and the parabromophenyl-propionic acid.

Action of Hydrobromic and Hydrochloric Acids upon Nitrobenzol.—H. Baumhauer.—Two and a half parts, by bulk, of a freshly-made aqueous solution of hydrobromic acid were mixed with one part, by bulk, of nitrobenzol, placed in a glass tube, and this, after having been sealed, was exposed to a temperature of from 185° to 190° . In this manner two substances were obtained—to wit, dibromaniline, which was in solution in the state of hydrobromate, and tribromaniline, which was left as an insoluble solid. When the experiment was repeated with hydrochloric acid, a crystalline substance was obtained, which the author has not further investigated.

Some of the Decompositions of Bromonitrous Acid.—M. L. de Koninck prepared this acid by means of saturating bromine cooled down to -10° with deutoxide of nitrogen; when an alcoholic solution of this compound is added to an alcoholic aniline solution, among other products, diazoamidobenzol is formed; when the aforesaid alcoholic solution was made to act upon nitrate of aniline, the author obtained a corresponding diazo compound. From these, and a series of similar experiments, the general result arrived at is that bromonitrous acid acts upon aniline as anhydrous nitric acid does upon that substance.

New Method of Preparing Cymol from Camphor, and on a Hydroxyl Derivate of Cymol.—Dr. R. Pott, while experimenting with camphor ($C_{10}H_{16}O$), tried to displace its oxygen by sulphur; and with that view he made sulphide of phosphorus, P_2S_5 , act upon the substance; but, instead of succeeding with his intended substitution, he obtained cymol, since the sulphide of phosphorus acts by withdrawing water from the camphor, while, as by-product, a small quantity of a resin is formed at the same time. The best proportions for obtaining cymol by this method are five atoms of camphor to one atom of P_2S_5 ; the product obtained is purified by means of concentrated solution of caustic potassa and rectification over sodium. The hydroxyl derivative is obtained by fusing cymol with an excess of a mixture of potassa and sulphite of potassa, whereby a substance is formed the formula of which, after having been properly purified previous to analysis, is $C_{10}H_{14}O$, a substance, therefore, to which the name thymol applies.

Hydroxyl Urea.—Drs. Dresler and Stein find that this substance originates when cyanate of hydroxylamine is formed from cyanate of

potassa and a salt of hydroxylamine; the preparation of the hydroxyl urea, $N_2CH_4O_2$, is very complex, and, in consequence of the manifold operations required, too lengthy for description here. The resulting substance just alluded to is a solid, readily soluble in water, crystallises from alcoholic solutions in needle-shaped crystals, and fuses at between 128° and $130^\circ C.$; but if it be kept at this temperature for some time, it is decomposed, carbonate of ammonia is given off, and ordinary urea left. It is probable that the hydroxyl urea is, however, during this process of decomposition, first split up into cyanic acid and hydroxylamine. Solution of caustic potassa and strong nitric acid immediately decompose the hydroxyl urea. The author describes, also, a substance which he calls hydroxylbiuret, the formula of which is $N_3C_2H_5O_3$; it is a solid, soluble in water and alcohol, fusible at $134^\circ C.$, but very readily decomposed, if kept, even for a few minutes, at this temperature.

Combination of Phosphoric Acid and Urea.—MM. Schmelzer and Birnbaum have repeated some of Lehmann's experiments on this subject; they dissolved urea in a concentrated solution of ordinary phosphoric acid, and evaporated the fluid, without being warmed at all, over sulphuric acid in vacuo. In this manner a crystalline mass is obtained, which may be purified by re-crystallisation, after having been dissolved in distilled water and cautiously evaporated on a water-bath; the crystals thus formed belong to the rhombic system, are readily soluble in water and alcohol, difficultly so in ether. The substance becomes decomposed when it is heated above 100° , giving off ammonia and carbonate of ammonia, and leaving metaphosphoric acid; the formula of this substance is CH_4N_2O, H_3PO_4 . The authors state that other similar compounds have been obtained by them, and among these one containing 39 per cent P_2O_5 , but this substance does not assume a crystalline shape.

Under the title of "Results of Researches made in the Chemical Laboratory of Professor Engelhardt, at St. Petersburg," a paper follows, which is divided into three sections, each having a separate title:—1. "Nitrotoluol and Amidotoluolsulpho Acids," by M. Bek. 2. "Isomeric Toluidine Sulpho Acids," by J. Malyscheff. 3. "Isomeric Naphthol and Benzoylnaphthol," by Maikopar. However interesting these researches may be, the papers are too concisely written to admit of useful abstraction; and, from a foot-note placed at the end of these essays, we learn that researches on the same subjects have been made simultaneously elsewhere, and published, previous to the authors of the researches here referred to having had time to get their work printed and published in German.

The remaining few pages of this number of the periodical are filled with short paragraphs taken from the *CHEMICAL NEWS*, *Comptes Rendus*, and other periodicals, the subject matter of all of which has been noticed and published in our pages.

Les Mondes, Revue Hebdomadaire des Sciences, May 13, 1869.

We briefly notice, from the contents of this weekly paper, which are extremely varied, a proposal by M. Guignet—

To Preserve Butcher's Meat in Hot Weather, by placing it in large earthenware pans, putting clean heavy stones on it, and covering it with skim milk; the milk will become sour, of course, but may afterwards serve as food for pigs, and the meat will be found to have kept its natural primitive freshness, even after eight or ten days.

Bronze.—It appears that at Berlin experiments have been made to determine under what circumstances the metallic alloy known as statuary bronze becomes most readily covered with what is technically called *antique patina*. As the result from a series of experiments, it appears that when genuine bronze is kept well cleansed, by washing the objects made of it with water, and next varnishing with oil, and rubbing the latter off with a piece of woollen stuff, and repeating this process once a month, it will produce the desired coating of patina very rapidly. Few of our readers acquainted with London are aware, perhaps, that the lamp-posts on London Bridge are, not as they seem, cast-iron, but genuine bronze, which of course, owing to the atmosphere it is exposed to, has become black.

Among the papers on geognosy, we meet with an interesting account of amber, too long for abstraction. This latter observation also applies to a paper of M. Dufour, on "An Improved Method of Examining the Flame of Burning Bodies and the Structure thereof."

The remainder of the papers relate to pure mathematics, and a long account of the meeting of the French Academy of Sciences.

Bulletin de la Société d'Encouragement, No. 195, March, 1869.

All the original papers of this number bear upon matters of engineering and mechanical science. The industrial notices contained in this publication, taken, as they are, chiefly from German papers, are rather antiquated; we only briefly notice—

Good Wholesome Bread.—Professor Stohmann advises to mix to $\frac{2}{3}$ parts of rye meal, $\frac{1}{3}$ part of bean, or pea meal, and 2 per cent, by weight, of the mixture, of ordinary common salt. It appears that bread thus made is of excellent quality, taking its constituents into consideration, and easily digestible.

Copal Varnish, according to Professor Büttger's prescription, should be made by first dissolving one part, by weight, of camphor, in twelve parts of ether; when the camphor is dissolved, four parts of the best copal resin, previously reduced to an impalpable powder, are added to the ethereal camphor solution, placed in a well-stoppered bottle. As soon as the copal appears to be partly dissolved, and has

become swollen, four parts of strong alcohol, or methylated spirits, and $\frac{1}{4}$ part of oil of turpentine is added, and, after shaking the mixture, and letting it stand for a few hours longer, a thoroughly good copal varnish is obtained.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 6, 1869.

At the meeting of the Society held on the 22nd of March, under the presidency of Professor A. W. Hofmann, the following papers were read:—

Peculiarly-Modified Physical Structure of Banca Tin.—M. J. Fritsche states, that during the intense cold of the winter weather at St. Petersburg in the months of December, 1867, and the first three months of the following year, a large quantity of blocks of Banca tin, warehoused in that city, had been entirely changed in physical properties; the metal was swollen up, and the inside of the blocks, which had become simultaneously very brittle, so as to break very easily, had been entirely honeycombed. M. Fritsche instituted some experiments, by submitting tin of the same kind, not previously affected by the winter cold, to the action of an artificial freezing mixture made of solidified carbonic acid and anhydrous ether, without obtaining anything like the results produced by the long-continued intensely cold winter. No chemical change had been produced; as usual, this kind of tin was of great purity.

Some Derivatives of Naphthol and Naphthobioxyl.—MM. Darmstädter and Wichelhaus.—The authors say that they have met with considerable difficulty to obtain nitro-derivatives of naphthol by directly acting with nitric acid upon that substance; when, however, a solution of naphthol-sulphuric acid is placed in contact with nitric acid, a red colouration ensues, and a solid yellow-coloured substance is precipitated; this substance is the binitronaphthol, which crystallises from its solution in chloroform, and fuses at 138° C. Naphtho-bioxyl, obtained by fusing naphthalin-bisulphuric acid (naphthalin-bisulfosaure) with caustic potassa, is a solid substance which crystallises in colourless needle-shaped crystals, soluble in alcohol, ether, and chloroform, difficultly soluble in water; formula, $C_{10}H_6(OH)_2$.

Changes which Orthoformic Ether Undergoes.—M. H. Wichelhaus.—Orthoformic ether, $CH(OC_2H_5)_3$, when heated in sealed tubes with liquid ammonia, did not yield the product the author sought for; but, on repeating the experiment with aniline and the same ether, a solid substance was obtained, which, on being submitted to elementary analysis, yielded results leading to the formula $C_{13}H_{12}N_2$, thereby proving, in connection, also, with the chemical and physical properties of the substance, that it is identical with the body Dr. A. W. Hofmann obtained from chloroform and aniline.

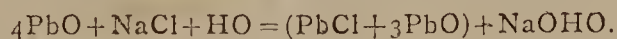
"Substances Isomeric with Hydrosulphocyanic Ether which agree with the Essential Oil of Mustard," by Dr. A. W. Hofmann. This lengthy and very concisely written, and evidently condensed, paper, is too long for abstraction, with due justice to the merits of the researches described and to the eminent author.

The papers which follow, and the correspondence, have been noticed in our pages already.

Annales du Génie Civil, April, 1869.

As may be expected from the title, this periodical only occasionally contains papers, or communications, relating to chemistry. We notice in this number:—

Bachet's Process for the Manufacture of Caustic Soda.—When litharge, chloride of sodium, and water are mixed together, oxychloride of lead is formed, and soda set free, according to the following equation:—



The oxychloride of lead thus produced being treated with milk of lime, chloride of calcium is formed, and oxide of lead reproduced according to this equation:—



The operation, therefore, consists in making oxide of lead act upon common salt, exhausting the soda thus formed by washing out with water and evaporating the alkaline fluid. The oxychloride of lead being insoluble, is placed in suitable apparatus, and mixed therein with lime-water, whereby the oxychloride is re-converted into protoxide of lead. The chloride of calcium obtained as by-product is, however, at present almost entirely valueless.

New Manure.—We learn from the same paper that a double salt of sulphate of ammonia and sulphate of manganese, found in the mother liquors remaining from the boracic acid manufacture at the *lagoni* of Tuscany, a salt hitherto useless, though containing from 7 to 8 per cent of ammonia, and about 10 per cent of protoxide of manganese, is now applied as manure, instead of crude sulphate of ammonia, and gives excellent results; as attested, also, by the well-known Prof. George Ville.

Comptes Rendus des Séances de l'Académie des Sciences, Monday, May 17, 1869 (No. 20).

Omitting matters of purely mathematical, astronomical, and mechanical interest, we notice the following memoirs:—

Expansion, by Heat, of some Metallic and Non-Metallic Simple Bodies, and some Compounds of Hydrogen and Carbon.—M. Fizeau has experimented upon some forty substances,

nearly one-half of which number has been for the first time submitted to a rigorously exact method of determining the co-efficient of expansion by heat between 10° and 80° C., and with masses varying from 2 to 16 m.m. The co-efficient of linear expansion of diamond is equal to 0.00000118; that of graphite, 0.00000786; that of pure cast platinum, 0.00000899; that of cast gold, 0.00001443; that of cast silver, 0.00001921; that of copper, native from Lake Superior, 0.0000169. These figures we quote only as instances of the amount of labour bestowed by the author on a subject requiring great nicety of manipulation.

On the Kaolin of La Lizolle and Echassieres, Departement of Allier, and Existence of Tin Ore at the same spot, which has been worked in remote antiquity.—M. Daubrée.—Although this memoir is certainly of local interest only in its geological, mineralogical, and commercial bearing, it deserves to be noticed, on account of the fact that the working of these kaolin beds, situated almost in the very centre of France, have been, at a very remote period of antiquity, the scene of mining operations, executed with the view of obtaining tin ore, from which, moreover, metal has also been wrought there, as evidenced by vestiges of furnaces found in the neighbourhood.

Some Properties of Chlorosulphide of Phosphorus.—M. Chevrer.—Chlorosulphide of phosphorus, $PSCl_3$, is a colourless liquid, possessed of a rather irritating, but not at all disagreeable odour; boils at 124.5° C.; (when barom. 750 m.m.) at 20° C., its specific gravity is 1.636; its vapour is difficultly combustible, and forms, when mixed with oxygen, a slightly explosive mixture. This substance is not decomposed by a strong electric current, or a series of electric sparks. When the vapour of this substance is made to pass through a red-hot porcelain tube, filled with pieces of broken porcelain, the vapour is partly decomposed, sulphur is deposited, and a mixture of chlorosulphide and protochloride of phosphorus distils over. Water has the effect of slowly decomposing the chlorosulphide of phosphorus, thereby converting it into phosphoric, hydrochloric, and hydrosulphuric acids. This substance is also decomposed by chlorine; iodine and sulphur are readily soluble in this liquid, which is not acted upon by metals at the ordinary temperature of the air. Space forbids us here to enter into more particulars on the chlorosulphide of phosphorus, which has been exhaustively studied by the author.

"Physical Constitution of the Sun; on the Results obtained by Spectrum Analysis, and by the Study of the Rotation of that Heavenly Body."—M. Faye, though an enthusiastic admirer of the results obtained by spectrum analysis, considers that the study of the mechanical effects of the rotation of the sun in producing certain phenomena on its surface, and in its photosphere, should not be neglected.—*Influence of Temperature, as Affecting the Deviation of Gases from Obeying Mariotti's Law,* by M. Amazeat. This is a condensed abstract from a larger paper, and too abstruse for further condensation.

Researches on the Phosphoric Acid present in that portion of Arable Soils which is Insoluble in Aqua Regia.—M. de Gasparin.—The labours of this gentleman reveal the fact, that even where there is the least appearance of the presence of phosphoric acid, it is met with in a quantity, which, if calculated for a surface of 1 hectare (2.471 acres), proves it to be relatively pretty abundant, though it be in a rather insoluble form. As instances, we take granitic sand from near Annonay (Ardèche), which in this way contains 0.62 per cent of its weight of this acid, amounting to 24,000 kilos. to the hectare. The siliceous diluvial sand of the borders of the Mediterranean contains 0.49 per cent, or nearly 20,000 kilos. to the hectare.

Solubility of Sulphur in the Coal-Tar Oils.—M. E. Pelouze.—Coal-tar oil, of 0.885 sp. gr., and distilling over at between 146° and 200° C., dissolves, at 15° , 2.3 grms. of sulphur; at 40° , 5.6 grms.; at 65° , 10.6 grms.; at 100° , 25.0 grms.; at 110° , 30.3 grms.; at 130° , 43.2 grms. As soon as the temperature decreases, the sulphur is precipitated in crystalline state, so that when the temperature was 130° , and the quantity of sulphur dissolved 43.2 grms., on cooling down to 15° only 2.3 grms. remain dissolved, and 40.9 grms. are precipitated. This property of the heavier coal-tar oils is made use of at the Paris gas-works to extract, from the materials which have been used in purifying gas according to Laming's process, the sulphur therein contained. The author of this paper reports very favourably on this plan, as greatly superior and less dangerous than the use of sulphide of carbon for that purpose.

This number also contains several papers relating to meteorology, and among these a very circumstantial account of the death, by lightning, of Captain Lacroix, of the Imperial Engineers, who was killed on the 7th of May last, while in his tent at the camp of Châlons-sur-Marne.

The American Journal of Science and Arts, March, 1869, No. 140.

This well-known and deservedly valued periodical contains, in its present number, the following original papers:—

"Some Phenomena of Binocular Vision," continued from a previous number, by Prof. Joseph Le Conte.

New Salt, containing Tin, Cæsium, and Chlorine.—S. P. Sharples.—This almost insoluble salt was accidentally discovered, and after having been purified, was found, on analysis, to consist, in 100 parts, of—chlorine, 35.84; tin, 19.49; cæsium, 44.67. The new salt will not serve for a quantitative separation of cæsium, as it is slightly soluble even in strong hydrochloric acid. Alcohol does not seem to have any influence upon the precipitation. If stannic chloride is added to a neutral solution containing $CsCl$, no precipitate is formed; but, upon adding to the solution about its own volume of strong hydrochloric acid, the salt is at once thrown down.

"Atomic Volume of Liquids," by Frank Wigglesworth Clarke. This extremely interesting and very concisely written paper is too lengthy for abstraction, an observation which equally applies to Dr. Wolcott Gibbs's paper "On the Wave Length of the Spectral Lines of the Elements."

"Condition of our Knowledge of the Processes in Luminous Flames," by Eugène W. Hilgard.—This paper contains a review of what is at present precisely, and with absolute certainty, known on a subject which, as the author well remarks, has been too much taken for granted. His paper, full of quotations from the papers and published memoirs containing the results of experiments by himself and many other scientific men, is too abstruse for abstraction.

Notices of New Meteoric Irons in the United States.—Charles Upham Shepard.—Meteoric Iron from Auburn, Macon County, Alabama; specific gravity varied from 7.0 to 7.17, and gave 7.03 as the mean. The iron is free from chlorine, dissolves in hydrochloric acid without giving off sulphuretted hydrogen, and leaves behind a slight residue of thin, brilliant, blackish scales and needles. Its percentage composition, by analysing 2 grms. weight, was found to be:—Iron, 94.580; nickel, 3.015; phosphorus, 0.129; insoluble, 0.523; chromium, magnesium, calcium, silicon (?), and loss, 1.753; total, 100.000.—Meteoric Iron from South-Eastern Missouri. Specific gravity, 7.015–7.112; no chlorine. In 100 parts:—Iron, 92.096; nickel, 2.604; schreibersite, 5.000; chromium, cobalt, magnesium, and phosphorus, traces; a fine residue of Fe_2O_3 , SiO_2 and C. Neither copper nor tin was found.—Meteoric Iron from Losttown, Cherokee Co., Georgia. In 100 parts:—Iron, 95.759; nickel 3.660; insoluble, 0.580; chromium, cobalt, tin (?), and magnesium, traces.

"Nitrification," by S. W. Johnson, is an essay on this subject, condensed from a lecture delivered before the National (American) Academy of Sciences.—"Geological Notes on the Andes of Ecuador," by James Horton.—"Observations on Autumnal Foliage," by Joseph Wharton, is a paper on chlorophyll and some observations and experiments made on this substance by the author, to which he has appended short abstracts containing the records of the results of the experiments on chlorophyll by Prof. Frémy and others; the author's experiments have more a physiologico-botanical, than a chemical bearing.

Modified Form of the Nitrate of Silver Test for Arsenic Acid.—Charles E. Every.—The author has thoroughly studied and experimented upon this subject. It is known that arseniate of silver is slightly soluble in an aqueous solution of nitrate of ammonium, and readily soluble in both ammonia and dilute nitric acid; it is not easy to detect small quantities of arsenic by means of nitrate of silver, as usually employed, unless the test be applied with extreme care. The author found that the addition either of acetate of sodium, acetate of ammonium, or Rochelle salt, to a mixed solution of arsenic and nitric acids, is sufficient to ensure the immediate precipitation of arseniate of silver when ammonio-nitrate of silver is introduced. Instead of the acetates or tartrates, recently precipitated carbonate of silver may be employed to neutralise free nitric acid. When present in relatively large quantity, arsenic acid readily precipitates silver from a solution of nitrate of ammonium and ammonio-nitrate of silver, but the colour is uncertain.

Next follow:—"Notices of Papers in Physiological Chemistry," by Dr. George F. Baker; a long essay continued from a former number of this periodical. The scientific intelligence which concludes this number is partly abstracted from articles of journals and periodicals published in Europe, and is partly of local interest only.

PATENTS.

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1143. P. A. Blake, Highbury, Middlesex, "An improved safety explosive compound, and the apparatus connected with its use."—Petition recorded April 14, 1869.

1193. J. Horsley, Cheltenham, Gloucestershire, "Improvements in the manufacture of blasting powder or explosive compounds."—April 19, 1869.

1260. J. Major, W. Wright, Swallow Street, Middlesex, and G. H. Jones, Alpha Road, Middlesex, "A new or improved manufacture of white-lead, and apparatus employed therein."—April 24, 1869.

1361. P. Southern, Top Lock, Aspull, near Wigan, Lancashire, "Improvements in furnaces."—May 3, 1869.

1380. W. MacKean, Paisley, Renfrewshire, "Improvements in the manufacture of cattle food."

1381. E. H. Richmond, King William Street, London, "Improved apparatus and process for preserving fresh meat and other animal food, fish, poultry, and game; also ingredients, matters, or substances to be used in combination with the said apparatus."

1383. H. Highton, M.A., Brighton, Sussex, "Improvements in making, hardening, and preserving artificial stone, and in preserving the surfaces of walls and other surfaces."

1388. T. Welton, Grafton Street, Fitzroy Square, Middlesex, "A new method of applying oxygenated and other gas-charged charcoal, for curative and other purposes."—May 5, 1869.

NOTICES TO PROCEED.

3945. E. Butterworth, Calder Cottage, near Rochdale, Lancashire, "Certain improvements in or applicable to furnaces."—Petition recorded December 26, 1868.

3965. A. G. Cazalet, Rue Gaillon, Paris, "Improvements in the manufacture of steel, and in the apparatus employed therein."—December 30, 1868.

26. W. Prosser, Lancaster, "Improvements in the purification and bleaching of oils, gums, and resins and spirits."—January 5, 1869.

905. J. J. Bodmer, Newport, Monmouthshire, "Improvements in the manufacture of iron and steel, and in the apparatus to be employed therein, part of which improvements are also applicable to the treatment of other metals and alloys."—March 25, 1869.

1083. J. Dewar, Kirkcaldy, Fifeshire, "Improvements in treating certain substances for food and for manure."—April 9, 1869.

NOTES AND QUERIES.

Alizarine.—It is as yet impossible to answer this question, since Messrs. Graebe and Liebermann do not manufacture on a sufficiently large scale to judge of the commercial success of their process.—F.

Bread for Diabetes.—Bread composed of gluten of wheat without starch, or bran-cakes baked with eggs, have been recommended. It is very likely that some of the higher-class bakers of the West End shops keep, or at least, if required, make, bread of this kind, as is the case in Paris.—H. C. S.

Bread for Diabetes.—Take coarse wheat-bran, wash it with water on a sieve until the water passes through clear, dry it in an oven, and grind to a fine powder by a mill. Take seven eggs, 1 pint of milk, $\frac{1}{4}$ lb. of butter, a few caraways or some powdered ginger, and make the whole into a paste with a sufficiency of the bran-flour. Divide the mass into seven equal parts, and bake each separately in a saucer by rather a quick oven; time about twenty minutes. Another way is to take potatoes, 4 lbs.; rasp them, and wash on a sieve as above; 3 ozs. mutton suet, three eggs, 2 ozs. butter, 1 drachm carbonate of soda; mix, and add $\frac{1}{2}$ fluid oz. pure dilute hydrochloric acid Lond. Pharm. Divide into two cakes, and bake immediately in a quick oven until nicely browned.—G. A. K.

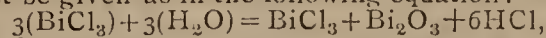
Sulphate of Manganese.—This substance is not used in the arts or manufactures to any extent; those who want it (as for instance calico-printers) either make it themselves or purchase it from manufacturing chemists, who only make it in any quantity when ordered; as to its price, any price-list of wholesale firms will give information.—L.

Carbonic Acid.—Carbonate of barium is by no means a mineral found in such quantities as to render it particularly adapted to the manufacture of carbonic acid on account of cheapness as compared with white marble, thousands upon thousands of tons of which, in the shape of chips, are burned for lime; and which, in small quantities, at stone-masons' and marble-work yards, may be had almost for the mere trouble of picking them up.—A.

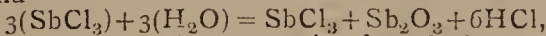
Magnesian Cement.—I have been trying the magnesian cement—an oxychloride of magnesium—discovered by M. Sorel, of Paris, and am struck with its cementive powers, even when mixed with much foreign matter. An invention apparently so excellent can hardly have been allowed to remain unnoticed without some reason. Are its hydraulic properties deficient? Are the materials too expensive for application on a large scale?—R.

Black Ink from Elder Berries.—The bruised berries are placed in an earthen vessel, and kept in a warm place for three days, then pressed out and filtered. The filtered juice is of such an intense dark colour that it takes 200 parts of water to reduce it to the shade of dark red wine. Add to $12\frac{1}{2}$ quarts of this filtered juice 1 oz. of sulphate of iron and the same quantity of crude pyroligneous acid; and an ink is prepared which, when first used, has a violet colour, but when dry is indigo-blue black. This ink is superior in many respects to that prepared with galls; it does not become thick so soon, it flows easier from the pen without gumming, and, in writing, the letters do not run into one another.—*Deutsche Ind. Zeitung*.

Oxychlorides.—The white precipitate, given by BiCl_3 in water is called an oxychloride by certain chemical writers (Bence Jones, H. Watts), whilst that given by SbCl_3 is called a compound of the trioxide and trichloride. Is not the one as much a compound of the trioxide, &c., as the other? Chemistry aims at being exact, and certainly needs it. Why not be exact in minor matters if possible? Could the first be given as in the following equation:—



and the second—



or could not both terms be got quit of, and these precipitates be classified under the basic salts?—JOHN D. MACDONALD, Urquhart, Inverness.

Wood Pulp.—According to M. Ouvli, who has thoroughly investigated this subject, excellent results are obtained when for a hundred-weight of wood pulp from 400 to 800 grms. of oxalic acid are used; this acid has the double advantage of bleaching the colouring matter already oxidised, and of neutralising the alkaline principles which favour such oxidation. He adds to the oxalic acid one pound, or a little more, of sulphate of alumina (not alum) entirely deprived of iron. The principal agent in this mode of bleaching is the oxalic acid, the power of which over vegetable colouring matter is well known; the sulphate of alumina has no bleaching power of its own, but it forms with the colouring matter of the wood an almost colourless lake, which has the effect of increasing the brilliancy of the pulp. Chlorine, chloride of lime, and any other mineral acids are decidedly injurious in the bleaching of all matters of this kind, and always leave a more or less deep yellow tinge.

Naphthaline Colours.—The discovery of fuchsine, and other colours derived from aniline, first caused the existence of very rich sources of colouring matters to be predicted in mineral oils and carburet of hydrogen in general. Therefore, since that period, chemists have devoted themselves to laborious researches in the same direction, in order to find new dyeing products. The method which M. Clavel has adopted, was suggested by the study of the circumstances which have since been explained respecting the formation of fuchsine. It is now, in fact, known that commercial aniline is a mixture of aniline and toluidine, and M. Hofmann has proved that it is a mixture of these two bases that produces the brilliant colour. Guided by the examination of these facts, M. Clavel has not sought in naphthylamine for a colouring matter by itself, but one likely to produce the colour by a mixture with another base, like naphthylamine, which has served to produce it, or with any other isomeric substance. The new colouring matter, then, is obtained by the direct oxidation of a product isomeric with naphthylamine, which is procured by distilling crude naphthylamine, produced by the reduction of nitro-naphthaline, and taking the products of higher distillation to mix with the naphthylamine. The dye obtained differs entirely from the colours extracted up to the present time from naphthylamine. We will describe, in a few words, the mode of operation:—The naphthaline being first treated with nitric acid of 1.33°, the resulting nitro-naphthaline is washed, and reduced, either by iron and acetic acid, or zinc and hydrochloric acid, or any other analogous means, so as to obtain a sufficient reduction; this reduction being made, distillation is proceeded with. In the first place, naphthylamine passes; the condensation is then easier; the fire is increased, and it is then that the second body, discovered by M. Clavel, presents itself. This body constitutes the generating matter; it is treated at 120° with 50 per cent of very dry nitrate of mercury; a quantity of naphthylamine, equal to the quantity of the body used, is then added, and left in contact for about a quarter of an hour; the mixture is then treated with boiling water containing a vegetable acid; the colouring matter is dissolved, and filtered to separate the crude matters. The solution thus obtained may be treated according to the ordinary methods, for instance, by means of a salt, the colouring matter will be separated from it; this dissolved in alcohol gives a red colour of a magnificent tone, finer and more solid than the colours now extracted from naphthaline and naphthylamine; it presents by itself on the threads or tissues of silk, tints with brilliant reflection, warmer and of a clear effect. Hitherto the nature of the body discovered has not yet been specified by the author; he is waiting to give the analysis and chemical composition of it; but we can already give the principal characters of the new product. This body, which passes at the higher distillation, distils at a temperature of about 300°; its vapours form, in condensing, a deposit which rapidly becomes brown on exposure to the air. In a state of purity it is solid below 15°; it has then a viscous appearance, similar to the consistency of butter; it becomes more liquid at a higher temperature.—*Moniteur Scientifique*.

MEETINGS FOR THE WEEK.

TUESDAY, June 1st.—Royal Institution, 3. Professor Grant, "On Stellar Astronomy."
THURSDAY, 3rd.—Royal Institution, 3. Professor Tyndall, "On Light."
— Royal, 8.30.
— Chemical, 8.
— Royal Society Club, 6.
FRIDAY, 4th.—Royal Institution, 8. Prof. Odling, "On the Simplest Organic Compounds."
— Geologist's Association, 8.
SATURDAY, 5th.—Royal Institution, 3. Mr. Deutsch, "On Semitic Culture."

TO CORRESPONDENTS.

ERRATUM.—Page 239, No. 493, column 2, line 31 from bottom, in the article "Purifying Water," for 4-10ths read 4 per cent.

M. P. Muir.—The process was fully described at the Chemical Society last session.

J. Lee, who enquires about aniline black, is referred to our Notes and Queries column.

H. K. L.—It would be obviously unfair to admit in these columns queries which are only of personal interest. These should properly be inserted in our advertising columns.

Jamie.—The book can be supplied on application to our publisher.

Communications have been received from J. Lec; P. M. Muir; W. Longworth; C. R. C. Tichborne; Professor Gunning (Amsterdam); F. Smith; W. H. Hancock; W. H. Perkin, F.R.S.; F. Field, F.R.S.; H. S. Ellis; J. C. Bowring; R. Kirwan; Dr. Lawson; T. Hill; M. Fletcher; E. Britten; Messrs. Townsend and Adams; J. Mercer; W. A. Todd; J. Davis; Griffiths, Bettison, and Co.; A. Jones (with enclosure); E. G. Tosh; W. Wyles; D. Brown; J. Kempster; W. Baxter; and J. J. Griffin and Sons.

BOOKS RECEIVED.

Cyclopædic Science; simplified by J. H. Pepper, F.C.S., Professor of Chemistry at the Royal Polytechnic Institution; with 600 illustrations. London: Frederick Warne and Co. New York: Scribner, Welford, and Co.

The American Journal of Obstetrics and Diseases of Women and Children; May, 1868, and May, 1869. Edited by E. Noeggerath, M.D., and B. F. Dawson, M.D. New York: W. A. Townsend and Adams. London: Sampson Low and Marston. Paris: J. B. Baillière.

NEW WORK BY DR. W. ODLING, F.R.S.

Just published, in crown 8vo., Price 4s. 6d., cloth,

Six Lectures on the Chemical Changes of Carbon, delivered before a Juvenile Auditory at the Royal Institution of Great Britain. By WILLIAM ODLING, M.B., F.R.S., Fullerian Professor of Chemistry, Royal Institution. Reprinted from the CHEMICAL NEWS, with Notes by WILLIAM CROOKES, F.R.S., &c.

London: Longmans, Green, and Co., Paternoster Row.

MATRICULATION AND SCIENCE EXAMINATIONS, UNIVERSITY OF LONDON.

Arithmetical Exercises for Chemical Students, by C. J. WOODWARD, B.Sc., consisting of Problems and Worked Examples in the subjects of Specific Gravity, Metric System of Weights and Measures, Calculation of Formulæ from Percentage Composition, the Crith and its Uses, Thermal Units, &c.

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London: Simpkin, Marshall, and Co. Birmingham: The Educational Trading Co., Limited, 29 and 30, Union Street.

Just published, demy 8vo., price 6d.

On English and Foreign Alkalimetric and Chlorimetric Degrees, by John Pattinson, F.C.S. Read before the Newcastle Chemical Society.

London: CHEMICAL NEWS Office, Boy Court, Ludgate Hill, E.C.

Chemical Technology, or Chemistry in its Applications to the Arts and Manufactures. By THOMAS RICHARDSON and HENRY WATTS. Second Edition, illustrated with numerous Wood Engravings.

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Glass, Clay, and Limes.

Vol. III., on Food, Sugar, &c., is at present out of print.

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The Session 1868—1869 will commence on the 1st of October, when Mr. BRAITHWAITE'S Laboratory, which has been enlarged, will be re-opened at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS meets as usual every Monday and Thursday Evening, at 8 p.m.; commencing October 1st.

The LATIN CLASS for the reading of the Pharmacopœia, Physicians' Prescriptions, &c., every Tuesday and Friday Evening, at 8 p.m., commencing October 2nd.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday Evening, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday until further notice.

Fee to either of the above Classes Half-a-Guinea per Month; to the Botanical Excursions only, Half-a-Guinea per Eight Lessons. Pupils can enter at any period.

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Mr. Braithwaite receives a few Pupils to board in his house.

THE CHEMICAL NEWS.

VOL. XIX. No. 496.

RESEARCHES ON TURACINE,

AN ANIMAL PIGMENT CONTAINING COPPER.*

By A. H. CHURCH, M.A. Oxon.,

Professor of Chemistry in the Royal Agricultural College, Cirencester.

FROM four species of *Touraco*, or plantain-eater, the author has extracted a remarkable red pigment. It occurs in about fifteen of the primary and secondary pinion feathers of the birds in question, and may be extracted by a dilute alkaline solution, and re-precipitated without change by an acid. It is distinguished from all other natural pigments yet isolated, by the presence of 5.9 per cent of copper, which cannot be removed without the destruction of the colouring matter itself. The author proposes the name *turacine* for this pigment. The spectrum of turacine shows two black absorption bands, similar to those of scarlet cruorine; turacine, however, differs from cruorine in many particulars. It exhibits great constancy of composition, even when derived from different genera and species of plantain-eater; as, for example, the *Musophaga violacea*, the *Corythaix albo-cristata*, and the *C. porphyreolopha*.

CONTRIBUTIONS TO ANALYTICAL CHEMISTRY.†

By DR. E. FLEISCHER, of Dresden.

ON THE EMPLOYMENT OF CONSTANT FACTORS IN THE CALCULATION OF INDIRECT ANALYSES.

IN the calculation of indirect analyses, it is of the highest importance that a factor should be found which, when multiplied by the weight of one of the substances to be estimated, gives the weight of the other. For the determination of this factor, the rule is to form two equations, expressing the relations of the atomic weights of the substances in question from different points of view. These constant factors may, however, be obtained more quickly and simply, without the assistance of equations, by the following method, which, besides facilitating calculation, is capable of employment by persons not sufficiently versed in mathematics to solve common equations.

Suppose two substances, X and Y, each of which is chemically combined with an acid or base: these two salts may be expressed by the common formula $(X+C) + (Y+C)$; and consider the collective weight of these two compounds, which is found, by directly weighing, as equal to G. If we now assume that base or acid (to whichever the substances X and Y may be combined) is determined by analysis, and that this amount is represented by the weight C, X and Y will be the two substances to be found by calculation, and of which nothing further than their atomic weight is known.

Now, proceed as follows. First calculate what the weight of this salt would be if C were combined with the body X, having a smaller atomic weight than Y. Deduct this weight, which I will call *g*, from the collective weight of the two salts, which was G, and multiply the remainder by the constant factor S; the product will then be either $(G-g)S=Y$, or equal to the weight of the one substance, possessing the highest atomic weight which was to be indirectly found. The weight of X is obtained quite

simply by deducting the sum $Y+C$ from the collective weight G.

The determination of the constant factor ϕ is easily effected in the following manner. Suppose the two salts $X+C$ and $Y+C$ to be mixed together in the ratio of equal atomic weights, and add their atomic weights together. From this amount subtract the doubled atomic weight of the salt $X+C$ (supposing X to be larger than Y), and divide the remainder by the atomic weight of Y; the quotient will then be the required constant factor for the case in point. Two examples in figures may, perhaps, render this mode of calculation more clear. The amount of K and Na contained in a weighed mixture of chloride of potassium and chloride of sodium is to be determined, the collective amount of chlorine having been ascertained in the volumetric mode, by means of a solution of standard silver; the required factor ϕ is then found as follows:—

$$\begin{array}{r} 1 \text{ equiv. K Cl} = 74.6 \\ + 1 \text{ ,, Na Cl} = 58.5 \\ \hline \end{array}$$

$$\begin{array}{r} \text{Hence—} 1 \text{ equiv. KCl} + 1 \text{ equiv. Na Cl} = 133.1 \\ \text{When deducting—} 2 \text{ ,, Na Cl} = 117.0 \\ \hline \end{array}$$

$$\text{A remainder is left of—} \quad 16.1$$

This remainder of 16.1, divided into the atomic weight of K=39.1, gives, as a constant factor,—

$$\phi = \frac{39.1}{16.1} = 2.4285.$$

Let us suppose that the united weights of chloride of potassium and chloride of sodium amount together, in a given case, to 1.916 grms., while the total amount of chlorine found weighs, when calculated as chloride of sodium, 1.755 grms. The difference between these two weights will then be—

$$\begin{array}{r} 1.916 \text{ grms.} \\ - 1.755 \text{ ,,} \\ \hline 0.161 \end{array}$$

This remainder of 0.161 grms. gives, when multiplied by the constant factor 2.4285, the amount of potassium 0.390988 grms., or, in round numbers, 0.391 grms. of potassium. This weight, and the ascertained total of chlorine, viz., 1.065 grms., deducted from the weight of both salts = 1.916 grms., gives $1.916 - 1.065 - 0.391 = 0.460$ grms. of sodium.*

Let us take as our second example the estimation of chlorine, bromine, and iodine, in combination, by a solution of nitrate of silver. Several simple methods of effecting this are known. Among them is one I would especially recommend, in which the iodine is separately estimated, by distillation with sesquichloride of iron, or by precipitation as subiodide of copper; while the amount of silver required for precipitating the three silver compounds is determined by subsequently ascertaining the silver contained in the filtrate, and deducting it from the measured testing solution employed. This method is preferable, because one weighing of the chloride, bromide, and iodide, of silver, with the addition of the iodine already found, and the ascertained quantity of silver, suffices to calculate the weight of the three halogens where several weighings would be required.

I have intentionally chosen the most complicated method of calculation, in which the directions are as follows:—Weigh the amount of precipitated chloride, iodide, and bromide of silver, then transform all the chloride into bromide of silver by a lengthy digestion with bromide of potassium (which must be quite free from iodine), weigh the precipitate, which will now consist of only bromide and iodide of silver, and digest the weighed precipitate with iodide of potassium, whereby all the bromide of silver is changed into iodide, and the precipitate, which is to be again weighed, will contain merely silver and iodine.

* Abstract of a paper read before the Royal Society, May 27th, 1869.
† Communicated by the Author.

* The potassium and sodium contained in the mixed salts are therefore found by calculation.

It will be perceived that the last weighing of the iodide of silver only serves to ascertain the total amount of silver which is contained in all the precipitates: if this be known, the transformation of the bromiodide of silver into iodide of silver by iodide of potassium can, of course, be omitted, and also the third weighing. Thus we have here determined the amount of silver which was combined with the three halogens, chlorine, bromine, and iodine. The same amount of silver was also contained in the precipitate of bromiodide of silver. We will now calculate the constant factor for these two combinations in the following way:—

$$\begin{array}{rcl} 1 \text{ equiv. AgBr} & = & \dots\dots\dots 188 \\ + 1 \text{ ,, AgI} & = & \dots\dots\dots 235 \\ \hline \end{array}$$

$$\begin{array}{rcl} 1 \text{ equiv. AgBr} + 1 \text{ equiv. AgI} & = & 423 \\ \text{Thence deducting—} 2 \text{ ,, AgBr} & = & \dots\dots\dots 376 \\ \hline \end{array}$$

Gives as remainder— 47

If we divide 127, the atomic weight of iodine, by the remainder, 47, the constant factor between bromide and iodide of silver will be—

$$\phi = \frac{127}{47} = 2.7021$$

The factor between chloride and bromide of silver, which is also required, is calculated in a similar manner—

$$\begin{array}{rcl} \text{AgCl} & = & \dots\dots\dots 143.5 \\ \text{AgBr} & = & \dots\dots\dots 188.0 \\ \hline \end{array}$$

$$\begin{array}{rcl} \text{AgCl} + \text{AgBr} & = & 331.5 \\ \text{Hence—} 2 \text{ AgCl} & = & \dots\dots\dots 287.0 \\ \hline \end{array}$$

And 80 Br, divided by the remainder, 44.5, gives—

$$\phi = \frac{80}{44.5} = 1.7977$$

as the factor between AgCl and AgBr.

Let us now suppose the weight of the third deposit to amount to 1.645 grms.; its proportion of silver (similar to that in the other deposits) will therefore amount to 0.756 grms.; and, supposing the weight of the iodide and bromide of silver (the second precipitate) to be 1.363 grms., the amount of iodine may be calculated as follows:—

The weight of AgI + AgBr was— 1.363 grms.

Thence deducting the amount of AgBr

which corresponds to the weight of

silver of 0.736 grms., namely— 1.316

The remainder of— 0.047

multiplied by the factor ϕ for iodide and bromide of silver, 2.7021, gives—

$$0.047 \times 2.7021 = 0.1269987 \text{ grms. of iodine.}$$

Let us assume that the weight of the first precipitate of chloride, bromide, and iodide of silver amounts to 1.185 grms.; there will then remain, after deducting the amount of Ag corresponding to the iodine found,

$$\begin{array}{rcl} 1.185 \text{ grms.} & & \\ - 0.235 \text{ ,,} & & \\ \hline \end{array}$$

a remainder of— 0.950

which represents the collective weight of the chloride and bromide of silver.

Since, then, the collective weight of silver amounts to 1.756 grms., and that contained in the form of iodide of silver to 0.108 grms. (corresponding to 0.127 grms. of iodine), the weight of silver which was contained in the first deposit as AgCl and AgBr is $0.756 - 0.108 = 0.648$ gm. This amount of silver, when considered as chloride of silver, gives 0.861 gm. AgCl; and this, subtracted from the weight of chloride and bromide of silver, gives—

$$\begin{array}{rcl} 0.950 \text{ gm. AgClAgBr} & & \\ - 0.861 \text{ ,, AgCl} & & \\ \hline \end{array}$$

a remainder of— 0.089

which, when multiplied by the factor between chloride and bromide of silver, $\phi = 1.7977$, gives—

$$0.089 + 1.8 = 0.160 \text{ gm. Br.}$$

Lastly, if the collective weight of silver, together with that of the iodine and bromine, be deducted from the weight of the first precipitate of chloride, bromide, and iodide of silver, the weight of the chlorine will be $1.185 - 0.756 - 0.127 - 0.160 = 0.142$ grms. The substance in question contains, therefore, about 1 equiv. of iodine, 2 of bromine, and 4 of chlorine.

Indirect analyses are always very good for rapid estimations without separation, but they are specially recommended when the known methods of separation are very minute, and therefore give rise to faults; or if the amount of one body be much larger than that of the other, which renders separation more difficult.

In the succeeding description of the estimation of baryta, strontia, and lime, the convenience of indirect analysis will be specially demonstrated; and it is hoped that the mode by calculation, above explained, and which is as simple as it is quick, will no longer be disregarded.

ON THE METHODS OF DETERMINING

THE AMOUNT OF PRECIPITATED OR REDUCED PHOSPHATES IN ARTIFICIAL MANURES.

By JOHN HUGHES, F.C.S.

My attention has been directed to a communication from Mr. J. A. Chesshire (analytical chemist at the manure works of Messrs. Bradburn and Co., Wednesfield), published in a recent number of the CHEMICAL NEWS, in which a new method of estimating the amount of precipitated phosphates present in superphosphate and similar artificial manures is recommended, namely, that of boiling the portion insoluble in water for about half-an-hour with a solution of oxalate of ammonia, adding a few drops of oxalic acid.

I am surprised that any such process should have been recommended by a chemist, as it is an acknowledged fact that oxalate of ammonia, even in a cold solution, possesses the property of acting on insoluble phosphate of lime to an appreciable extent. Liebig has referred to this function of oxalate of ammonia when speaking of Peruvian guano, and has pointed out that this salt, which is present in guano in a variable proportion, plays an important part in rendering the insoluble phosphates to a certain extent soluble.

More recently, Dr. Voelcker, in a paper "On the Means of Increasing the Efficacy of Peruvian Guano" (published in the *Journal of the Agricultural Society*, 1864), has described some interesting experiments, which prove that oxalate of ammonia, which is always present, even in best Peruvian guano, has the effect of rendering the insoluble guano phosphates soluble. He found, moreover, that this effect is greater when comparatively little water is mixed with guano, and the concentrated solution of oxalate of ammonia thus produced is allowed to react for several hours upon the insoluble guano phosphates, than when much water is added, and the weak oxalate of ammonia solution is filtered off at once from the insoluble portion of the guano.

It might be urged that the peculiar solubility of a certain proportion of the phosphates in guano is probably due to the minute state of division in which they are present in this material; I have, therefore, made the following experiments with ground Cambridge coprolite, a phosphatic mineral, which is particularly hard, and which, I need hardly mention, contains no so-called "reduced" or precipitated phosphates.

Twenty grains of coprolite were boiled for about half-an-hour with 4 ounces of a solution which contained 10 grains oxalate of ammonia and 20 drops of oxalic acid solution (strength, 1 in 30); the insoluble portion was

then removed, and the phosphoric acid in the filtrate determined as pyrophosphate of magnesia, the results being calculated as tribasic phosphate of lime. A second experiment was made, in which 20 grains of oxalate of ammonia were added, instead of 10 grains.

The solution (filtrate), in the
1st experiment, contained phosphoric acid 3.48 per cent
(Equal to tribasic phosphate of lime 7.61) ,,
2nd experiment, contained phosphoric acid 4.60 per cent
(Equal to tribasic phosphate of lime 10.05) ,,

As it might appear that free oxalic acid was the principal agent in rendering the coprolite phosphates soluble, I made another experiment, in which oxalate of ammonia alone was employed.

Twenty grains of coprolite powder, 40 grains oxalate of ammonia, and 4 ounces of water were digested for half-an-hour, and the solution subsequently treated in precisely the same way as before.

In this experiment, I found in the filtrate—

Phosphoric acid.. .. 5.38 per cent
(Equal to tribasic phosphate of lime 11.75) ,,

It will be seen that oxalate of ammonia acts with considerable energy upon hard mineral phosphates; it is natural, therefore, to suppose that it will render soluble the insoluble phosphates frequently present in artificial manures, in the shape of bone or bone-ash, to a greater extent than it will hard mineral phosphates.

Your correspondent assumes that the plan of boiling out the insoluble portion of a manure with citric acid, is the one now generally employed in estimating the amount of precipitated phosphates, but I do not know any laboratory in which this practice prevails; at all events, the citric acid plan has been found impracticable in Dr. Voelcker's laboratory, where I am engaged at present.

Recently-precipitated phosphates, unquestionably, are more valuable than raw mineral phosphates; still, it cannot be maintained that they are as efficacious and valuable as phosphates actually soluble in water.

As long as we cannot separate with accuracy precipitated from ordinary insoluble phosphates, it is certainly objectionable to introduce into analytical statements the term "precipitated" or "reduced" phosphates.

There is no difficulty in broadly distinguishing between phosphates actually soluble in water and phosphates insoluble in water; and it appears to me desirable to adhere to the present plan of guaranteeing the quality of mineral superphosphates—by stating the percentage of soluble and insoluble phosphates which they contain.

ON THE FUNCTIONS OF NUCLEI

WITH RESPECT TO GASEOUS, SALINE, AND VAPOROUS
SOLUTIONS.*

By CHARLES TOMLINSON, F.R.S., F.C.S.

As every one here present is engaged in conducting processes in chemistry and pharmacy, you will, I am sure, be interested in some new experiments connected with the solution of gases, crystallisation, ebullition, and distillation, which I shall have the honour of performing before you.

You know that when a bottle of soda-water is emptied into a glass, there is not only an escape of gas from the surface of the liquid, but innumerable bubbles become attached to the inner surface of the glass. A crumb of bread, thrown into the soda-water, produces a lively effervescence; and, if we put into it the finger, a strip of paper, a rod of glass, of metal, or of wood, it immediately becomes covered with gas. In fact, any solid acts as a

nucleus in separating gas from solution; and I would define a nucleus as a body that has a stronger adhesion for the gas of a solution than for the water which holds the gas in solution.

Let us now take a glass that has been made chemically clean by being washed out with strong sulphuric acid, or caustic alkali, and copious rinsing with clean water. If the soda-water be poured into this, the results are very different. After the first effervescence is over, the glass looks as if it were full of pure distilled water, not a bubble of gas is to be seen adhering to the sides, and there is no appearance of gas any where about it. I plunge into the liquid a glass rod that has been made chemically clean, or *catharised* as it may be called: there is no escape of gas, not a single bubble adheres to the glass rod. I put in clean iron filings: there is no liberation of gas. I pour some iron filings into my hand, and rub them about, and, on putting these into the soda-water, there is a furious, boiling effervescence.

Hence, you see, there is a marked distinction between a clean or *catharised* body, and an unclean body, or *nucleus* as it may be called.

The action of nuclei may be similarly traced in the case of certain salts that form supersaturated solutions. For example, 100 parts of water, at 212° F., will take up 357½ parts of potash alum; whereas, at 32°, the water will take up only 3.9 parts, and yet the solution, saturated at 212°, may be cooled down to 32°, without any separation of the salt, provided the vessel containing it be chemically clean, the solution clean, and means be taken to exclude the dust of the air. Such a solution is said to be *supersaturated*, because it holds more salt in solution than it can take up at the reduced temperature. In the case before us, a solution of alum, saturated at 212°, and cooled down to 32°, contains 90 times more salt in solution than it can take up at 32°. Here is a solution of alum, saturated at 194°, and containing 53 times more salt than the water, at 32°, can take up. You see it is a perfectly clear and bright solution, and may be shaken with impunity. It remains liquid and supersaturated simply because there is no nucleus to start the act of crystallisation. I take out the plug of cotton-wool from the flask; and you see how beautifully the surface of the solution becomes covered with a crystalline crust, while well-shaped octahedra grow downwards, until the whole mass is solid, and the flask quite warm from the heat developed by the change of state.

Here is a supersaturated solution of sodic sulphate in a narrow-necked flask. I take out the cotton-wool, and the solution does not crystallise; I touch the surface of the solution with a glass rod, and crystallisation instantly sets in.

Here are similar solutions of sodic sulphate and sodic acetate, each containing a solid, such as a bit of charcoal, of pumice-stone, of meerschaum, of coke, &c. These bodies, which would act as nuclei in inducing crystallisation if put into the cold solution, become inactive if boiled up with the solution, and allowed to cool down with it and in it; they are, in fact, chemically clean. I take the cotton-wool out of these flasks; some of the solutions will crystallise on the instant, others after a short time, others, again, after some hours. It depends very much on the size of the opening whether a speck of dust enter the flask; for, of course, the wider the opening, the more likely is it for the dust to find an entrance.

In the case of saline solutions, a nucleus may be defined as a body that has a stronger attraction for the salt of a solution than for the liquid which holds it in solution.

In general, a body that has been exposed to the air, or handled, or wiped with a cloth that has been handled, is covered with an oily, fatty, or greasy film, to which the water of the solution adheres either not at all, or less strongly than does the salt of the solution, and, hence, such a body introduced into the solution, acts as a nucleus. Make the body chemically clean, and the solution adheres to it as a whole; that is, there is the same amount of ad-

* A lecture delivered at the *conversazione* of the Pharmaceutical Society, May 18th, 1869. Communicated, with additions and corrections, by the author.

hesion between the nucleus and the water of the solution as there is between the nucleus and the salt of the solution, and, hence, there is no separation.

An extreme case of this kind of perfect adhesion on the part of chemically-clean surfaces and the solutions, may be seen in this flask. It contains a highly-supersaturated solution of sodic sulphate, resting upon a considerable mass of the modified 7-atom salt. This, being chemically clean, does not act as a nucleus to the rest of the solution. I can shake the flask violently, so as to break up and rattle about these crystals at the bottom, and the solution does not solidify. But now, look at this: I take out the cotton-wool, and, instantly, lines of crystals, closely packed together, diverge from some point on the surface, and the whole saline contents of the flask form one solid mass.

This differential kind of action which belongs to nuclei, may also be exhibited with reference to liquids at or near the boiling point. My definition of such a liquid is, that it is a supersaturated solution of its own vapour. It is a solution of vapour, constituted like the solution of carbonic acid in water, or of sodic sulphate or of alum in water.

Such being the case, a body introduced into a liquid at or near the boiling point acts or does not act as a nucleus in separating vapour, according as it is unclean or clean. If clean, the solution adheres to it perfectly, and there is no separation of vapour; if unclean, the vapour adheres to the surface as strongly as before, but the liquid adheres less strongly, or not at all, and, hence, there is a separation of vapour on the surface of the nucleus.

Now, you are all acquainted with a very unpleasant phenomenon that often accompanies the processes of boiling and distillation. I mean the *bumping* of the vessel, or *jumping ebullition*, as it is called (*soubresauts*, in the language of French science). This is generally brought about thus:—The liquid makes the interior of the vessel chemically clean, and the solution of vapour adheres to the clean surface with great force; the temperature rises above the boiling point, until the liquid, not being able to dissolve any more vapour, a portion of the latter escapes with a burst along the line of least resistance, or towards the opening of the vessel. This upward action is accompanied by an equal reaction in a contrary direction, which tends to force the retort or flask further into the ring of the retort stand, or down upon any other support, and it is the rebound from this that causes the *soubresaut*. Now, for the purpose of preventing or mitigating this inconvenient and even dangerous action, it is the practice to introduce into the vessel certain angular or rough bodies, such as sand, pounded glass, bits of tobacco pipe, platinum, copper, &c. Such bodies have been called “promoters of vaporisation.” How they act has not been explained, but it has often been noticed that they cease to act in liberating vapour after prolonged contact with the boiling liquid.

I need scarcely say that such bodies cease to act as nuclei in liberating vapour from solution as soon as they become chemically clean.

Now, here is water boiling in a clean flask with some difficulty and a disposition towards bumping. I put into the flask a pinch of sand from the sand bath, and the boiling immediately becomes soft and regular, and there is no tendency whatever to bumping.

But suppose we make the sand chemically clean, by heating it in contact with strong sulphuric acid, rinsing with water, washing with alkali, and again rinsing. Such sand, in very small quantity, in a chemically clean flask containing clean distilled water, will increase the bumping to a remarkable extent. Here is such a flask, standing over a spirit lamp. You see that it bounds up from the support with explosive force, and one wonders the flask is not shivered to pieces. The bits of glass, &c., put into a retort containing alcohol, ether, &c., soon behave in this way, for the liquid makes them, as well as the interior of the vessel, chemically clean, and, in such case, we multiply the adhesion surfaces, when what is wanted is an extension of the vapour-giving surfaces.

It is clearly wrong to employ as nuclei bodies that soon cease to act as such, supposing it were possible to find permanent nuclei. Porous bodies, such as charcoal, coke, pumice-stone, &c., perform this useful function. The same force which enables a piece of boxwood charcoal, for example, to absorb 95 times its volume of ammoniacal gas, causes the charcoal, in the midst of a hot solution of vapour to absorb vapour, and, under the continued action of heat, to give it out again, in a constant, never-ceasing flow.

Indeed, what is remarkable is the permanent action of these porous bodies. I have tried the same piece of charcoal or of coke in boiling liquids over and over again, for weeks together, and never found the vapour-giving action to flag. I have boiled these porous bodies in strong acids, washed them in alkalies, and made them in all respects chemically clean, without at all interfering with their vapour-separating action in boiling liquids. They do not act as nuclei in separating salt from solution if boiled up with it and allowed to cool in it; their peculiar function is to separate vapour from liquids, at or near the boiling point; and this they do by their capillarity. I have, in this flask, a bundle of glass capillary tubes, united like a faggot, by means of a thread in the middle. This acts vigorously in separating vapour from the liquid at the boiling point, and, even after the lamp has been removed from under the flask, the tubes continue for some time to discharge vapour from their ends.

Among the charcoals, the most efficient as a vapour nucleus is charcoal from cocoa-nut shell. This is very dense, and sinks below the surface of liquids denser than water, which is a great advantage.

It will, I think, be worth your while to come up, after the lecture, and watch closely this large flask of water, containing some pieces of cocoa-nut shell charcoal. The vapour passes off from each piece in perfect torrents, and there are these two remarkable advantages connected with the action, namely, bumping is entirely prevented, and the amount of distillate is largely increased, in some cases as much as from 30 to 50 per cent, with the same amount of heat, in the same time, as compared with the process without the use of the charcoal.

For example, methylated spirit of wine, boiling at 171° F., was distilled in a glass retort. The distillate collected in five minutes weighed 244 grains. Three or four fragments of charcoal, partly boxwood and partly cocoa-nut shell, weighing only 20 grains, were added to the retort. The distillate, in five minutes, was now 325 grains. The ratio of the results is 100 : 133·2. With 20 grains of pumice-stone, the results were as 100 : 121·7; with 20 grains of meerschaum, as 100 : 112; and with 20 grains of coke, as 100 : 107·46.

But these results are understated; for the retort contained some porous specks of iron or charcoal, which get attached to most glass vessels during the process of manufacture, and which act as powerful nuclei in separating vapour from boiling liquids. Indeed, were it not for these accidental impurities, many a chemical operation must fail from excessive bumping.

But, as I promised to make this a short lecture, I must conclude. You see that there is a harmony of action in the behaviour of nuclei with regard to gaseous, saline, and vaporous solutions; and, from this action, we get a clear view of the functions of nuclei, and also get rid of much speculation as to “molecular action,” and “the mysterious action of the air,” which some observers indulge in when treating of supersaturated solutions.

Westphalian Iron Pyrites.—At the Paris Exhibition of 1867 there was a single block of pyrites from the Sicilian Pyrites Company, in Westphalia, weighing 4500 kilos. This piece was sent from the neighbourhood of Altenhunden-on-the-Lenne, and the mine yields now yearly 100,000,000 kilos. of this ore, which, according to an analysis made by Dr. Fresenius, contains from 42 to 45 per cent of sulphur, from 39 to 58 per cent of iron, and 0·02 per cent of arsenic. On an average, about 43 per cent of sulphur in this ore is available for making sulphuric acid.—*Bul. de la Soc. d'Encouragement.*

A CHEMIST'S VIEW OF THE SEWAGE QUESTION.*

By EDWARD C. C. STANFORD, F.C.S.

(Continued from p. 255.)

EARTH CARRIAGE.

THIS subject has been already brought before you; but as its chemical aspect has not been treated, I shall briefly allude to it. Some misconception appears to have prevailed here as to the disinfecting power of dry earth and ashes; both are absorbents of moisture, and to this extent, and no further, are these disinfectants. This may be easily proved by filtering putrid urine through either of these media; it passes unchanged.

These materials are only, therefore, deodorisers when largely in excess of the fœcal matter to which they are added.

Thus to take dry clay, the best substance of the kind, it would require three and a half times as much as the excreta, or 17,500,000 cubic feet to be brought into the city, and 22,500,000 cubic feet to be taken out again; and the actual value of this product would be £208,333, or 2½d. per cubic foot, or 6s. 7d. per ton. Its practical value would, however, be much less, because, on account of the expensive carriage, the value of a manure decreases in inverse geometrical proportion to its strength. It stands to reason, therefore, that if a dry vehicle is to be resorted to, it must be more economical to use some substance which increases, rather than diminishes, the agricultural value of the product, especially if less of it can be employed to do the same work. That substance, which, while acting as a deodoriser, also absorbed the most water for a given weight, and added its value to the product, should, theoretically, be the best for this purpose. I find that, while perfectly dry clay only absorbs 45 per cent of water, dry seaweed char absorbs 147 per cent, and the former becomes a sludgy mud, while the latter can be easily removed.

The use of an absorbent of this kind would, therefore, reduce the amount of material to be brought into the city to less than one-third, or to an amount equal to the excreta to be removed; or 5,000,000 cubic feet brought in, and 10,000,000 cubic feet taken out, annually, the daily removal being 385 tons in, and 770 tons out. This is not more than the present daily removal of ashes, while there would be no greater nuisance, and the value, exclusive of the value of the charcoal, would be about 15s. per ton. Viewed in this light, the dry closet system presents strong claims to notice, and, in a sanitary sense, its arrangements are perfect.

AIR CARRIAGE.

Carriage by atmospheric pressure possesses several advantages afforded by neither of the former systems, both of which add a large bulk of valueless, but costly, material to the excreta to be removed. Considering the great value, and easy application, of pneumatic pressure, it is remarkable that so little attention has been directed to it as a means of dealing with excreta; it has been entirely overlooked by those great authorities who have professed to look into all the bearings of this difficult question.

The principal effort in this direction is due to Captain Tiernur. I will briefly describe the main features of this proposition, referring to "The Sewage Question," by Krepp, for further details. Captain Tiernur proposes to place in houses a simple open-pan closet of a particular form, in connection with a vertical soil-pipe, and so shaped that the total excreta fall at once to the bottom of this pipe in the basement storey of the house, where it collects in a small syphon bend. The soil-pipe is made of earthenware, 14 to 16 inches in diameter, and is continued to the top of the house, where it is open to the air, and covered

with a wind-guard for ventilation. The syphon bend and bottom of the pipe are of cast-iron narrowed from the soil-pipe to a 5-inch cast-iron pipe. This is continued to a central receiver, sunk in the public street. This reservoir has about 20 cubic feet capacity; and allowing 1 cubic foot to every thirty-six individuals, each serves about 700 persons and a number of houses. Each house has a so-called house-valve, which is accessible from the street, and closes the connection with the sewage reservoir. This reservoir may be placed in any central position in the public street, sunk under the ground, and surmounted by an ornamental lamp-post, within which the two communicating pipes are concealed. It is of a nearly spherical shape, or quite spherical top and bottom, with cylindrical sides. It receives the drain-pipes from a number of houses, collected in four main branches, which enter it with a slight bend at the top; the house pipes and main pipes are all about 5 inch bore, the former entering the latter horizontally at an angle of 30°, and a curve of 2 feet radius. The main pipes have a gentle downward inclination towards the reservoir, but enter it by a sudden bend upwards. There are two vertical pipes concealed within the lamp-post—one, the air-pipe, about 3 inch bore, fixed to the top of the reservoir; and the other the exit soil pipe, about 6 inch bore, continued nearly to the bottom of the reservoir.

The mode of filling and emptying these receivers is by a "locomotive engine and pneumatic tender," which is drawn by one horse, assisted by the steam power of the engine, to the several reservoirs during the night. The process is simple; the engine works a powerful air-pump, which is placed in connection with the reservoir and the tender; in about three minutes the gauge indicates a vacuum of about 10 lbs. to the square inch, or about 20 in. barometer pressure, and both are sufficiently exhausted. The several house-valves are then opened and closed consecutively, and the contents of the syphons instantly shot into the receiver by the downward pressure of air in the soil-pipe, the vertical ventilating shaft acting like a pea-shooter. When all the house-traps are discharged, the air-pipe of the receiver is disconnected, the exit soil-pipe connected with the exhausted tender, the contents thus transferred to it, and the whole machine is driven off to the next reservoir; the foul gas from the air-pump is blown into the engine furnace. The tenders have each 100 cubic feet capacity, 10 cubic feet of which is used as a water-tank to the engine. When full, these are taken to "decanting houses," where the contents are transferred to barrels. These barrels are 28 inches in diameter, 32 inches long, about 5 cubic feet capacity, and made of strong oak staves bound with iron hoops; they form the stores for the manure, and for its transport, and are to be sold direct to farmers. For applying the contents directly to the soil, which is Captain Tiernur's special object, he proposes plans of ingenious manure ploughs and meadow manurers, which support the barrel and empty its contents at once into the furrow, where it is covered over and kept at once from decomposition. During frost, he proposes keeping these barrels in store.

The method of collecting, and particularly of applying, the excreta in these barrels, seems to me a most unnecessary complication. Glasgow would collect at the rate of 2,740 barrels a day, and a month's frost would accumulate an explosive store of 82,000 barrels; while in the summer I fear the barrels could not be used fast enough to prevent decomposition. There is also this great objection to this method, which applies, also, to irrigation, that we are compelled to sell our manure constantly to get it off our hands, and by making the farmer take it when he does not want it, and cannot advantageously apply it, we are entirely at his mercy, and must accept his prices; but if we could store it, make it into good manure, and sell it when he wants it, then, and not till then, can we expect to realise its value. If the other parts of this plan work well, a modification would make this feasible.

* Read before the Glasgow Sewage Association, March 30th, 1869.

We have a material to deal with in chemical works which presents some analogy with that under consideration; it must be kept from the air, it cannot be handled; but it is nearly double the weight of the excreta, and very corrosive. Yet this is lifted, without any difficulty, to great heights, and carried long distances, with no trouble and little expense, by atmospheric pressure; and could not the excreta be dealt with in the same way? The drain-pipes from the houses should be led into iron reservoirs, the size and number of these to be determined; the total daily removal being only 13,700 cubic feet, twelve cylindrical boilers with egg-shaped ends, about 10' \times 10', by 15 to 20 feet long, sunk vertically, would be sufficient for Glasgow. It might, however, be advisable to have smaller vessels in larger number; that is a matter of detail.

These reservoirs are all to be connected, by a small air-pipe, to one or more central pumping stations, where a powerful air-pump is fixed; each, also, to be furnished with an exit soil pipe, passing to the bottom, and continued up into a main pipe leading to one or two manure works situated some miles out of town.

This would, then, be the process of removal; at a fixed hour at night the air-pump would be set to exhaust a large iron reservoir at the pumping station, and communicating with the air pipes attached to the soil reservoirs. Two men for each district would then be sent round, and, opening the air-pipe valve, would place each receiver in connection with the exhausting pump, and then open, consecutively, the house-valves, by which means the soil-pipes would be nightly discharged, and the whole closet ventilated by a powerful blast of air. This is one operation. During the day, at a certain hour, the engine and air-pump would be reversed, and pump air into the air-vessel at the pumping station; the several soil reservoirs would then be placed in connection, and the contents lifted, by the atmospheric pressure, away to the manure works.

When we consider that a pressure of 50 lbs. on the square inch can be thus easily applied, there is merely the friction and some little weight to overcome; the plan seems quite practicable, and is, at any rate, worth a trial. The piping required would be an arterial system of small cast-iron piping; its cost, compared to sewers, would be little, and the cost for pumping must be insignificant, compared to that for lifting sewage in such enormous quantities.

The Abbey Mills pumping station has eight engines, 142 horse power each, or 1136 horse power; and these lift 15,000 cubic feet a minute 36 feet high. We have only to lift 385 tons, or 13,700 cubic feet, and the whole day's produce of Glasgow may be contained in a tank 30 feet square and 16 feet deep. These pumps, therefore, would do our day's work in fifty-four seconds.

When engineer's talk of intercepting sewers for our sewage, they mean immense culverts of brick, which leak in all directions, and are full of noxious gases, to carry off 137,000 tons of sewage a day, containing 385 tons, or 1-355th of excreta, and only 38½ tons, or 1-3550th of its weight, of solid excreta. My notion of a true intercepting sewer is a perfectly tight and cheap cast-iron pipe, which will really intercept this excreta, and deal with it alone. It is, to all intents and purposes, a fluid, and subject to all the laws of fluid pressure; to add 355 times its weight of water to *make it fluid*, is not only "carting coals to Newcastle," but it is paying very heavily for the pleasure of doing so.

Engineers should consider the possibility of removing, without nuisance, the excreta, as it is, from where it is to where it should be; because, if it can be so delivered, the further disposal of it can be safely left to chemists, who may, then, be fairly asked to turn it to account. We have not hitherto had a fair chance; engineers are allowed to mix the excreta with much water, and then to turn round and ask chemists to separate it again, forgetting

that the "*reductio ad absurdum*" is not a chemical process.

Dickens, in his preface to the last edition of "Pickwick Papers," after referring to the great improvements which have taken place since he wrote the work, ventures a hope that "it may some day be discovered that the universal diffusion of common decency and health is as much the right of the poorest of the poor as it is indispensable to the safety of the rich and of the state; that a few petty boards and bodies—less than drops in the great ocean of humanity which roars around them—are not for ever to let loose fever and consumption on God's creatures at their will, or always to keep their jobbing little fiddles going for a dance of death."

DECOMPOSITION OF REFRACTORY SILICATES BY FLUORIDES IN THE WET WAY.

By CHARLES E. AVERY,
Student in the Massachusetts Institute of Technology.

I FIND that silica and silicates, such as felspar and glass, may be completely dissolved in the cold by a mixture of some normal fluoride with almost any of the stronger acids, whether concentrated or dilute.

When mixed with the fluorides of sodium, barium, aluminum, lead, or the double fluorides of these metals, the silicates in question can be readily decomposed by nitric, chlorhydric and sulphuric acids, either concentrated or diluted with four volumes of water.

If strong sulphuric acid is used, a part of the silicon passes off as gas; if the dilute acid is used, portions of many silicates remain undissolved as insoluble sulphates.

The same decomposition of the silicates is effected, though less easily by the action of oxalic, acetic, tartaric, and like acids, on the mixed fluoride and silicate. Carbonic acid, even as dilute as in the air, does the same thing, but less rapidly.

Strong nitric acid gives a perfect solution and acts rapidly, dissolving a moderately fine powder of felspar or quartz in a few hours even in the cold. The loss of silica is very slight if the experiment is properly conducted; hence, all the constituents of a siliceous mineral can be estimated in the solution produced.

In analysing the silicates in this way, it is best to use the fluoride of some metal which is not to be estimated in the analysis; since, if we use a fluoride whose metal is present in the mineral, we must know the weight of fluoride taken. Of the various fluorides those of barium and lead seem to me the most promising.

An objection to the use of fluoride of ammonium is that, as usually made, it contains sulphate of ammonium, so that insoluble sulphates might be formed and solution retarded.

If fluoride of sodium, as made from cryolite, were not so hard to purify, it would be well fitted for the analysis of silicates free from sodium.

It has long been known that acid fluorides attack the silicates, and that even acetic acid can change normal into acid fluorides; but, so far as I know, no one has before shown that the action of acids is sufficiently rapid and complete, in the cold, to be useful in analysis. In another paper, I shall give the details of the process of solution, the method of analysis, and the means of making the fluorides.

Boston, February, 1869.

Quantitative Estimation of Sulphocyanides.—According to experiments instituted by Dr. Rüdorff, the estimation of the aforementioned salts, when neutral and soluble in water, is perfectly reliable when executed by means of titration with a neutral soluble silver salt. Experiments made by the author with properly re-crystallised sulphocyanides of ammonium and potassium yielded exactly the theoretical quantity; the salts experimented with had been purified by re-crystallisation from alcohol and afterwards drying.—*Poggendorff's Annalen*.

NOTICES OF BOOKS.

More Light: A Dream in Science. Wyman and Sons, Great Queen Street, Lincoln's Inn Fields.

IN the so-called "scientific world" we find a large number of men who do not work. The reasons why they do not work are not always so obvious as one would imagine. Some, including among them many of our most influential and successful men, do not work simply because they find it unnecessary. Fluent, strong in voice and in nerve; ambitious, and, perhaps, just the least thing in the world intriguing, they find it far more easy to acquire a position in scientific societies by criticising the researches of others than by working themselves. It is men like these who so mercilessly cross-examine the laborious workers who venture to read their papers before scientific bodies. These cross-examinations are, moreover, often carried on in a semi-bantering tone, as if the student had taken a liberty in bringing his results before a body, some of whose most august members found work unnecessary. And how often, in all countries, do we find the mantles of the greatest workers placed on the shoulders of these very men!

On the other hand, a vast number of those we meet in scientific circles do not work, simply because they prefer to dream. As there are people (even in this our day) who buy works on witchcraft and alchemy, not as curiosities, to be laid on the shelf until wanted as illustrations of the history of a past age, but to read them with reverence and faith, so there are men who revel in any darkness that has a savour of mystery. They have an instinctive repugnance of those physical truths which can be demonstrated by an appeal to the balance; as we have said, they prefer to dream; but we must do them the justice to say they generally keep their dreams to themselves. The author of the pamphlet before us is a man of a different stamp; he publishes his dreams, charges one-and-sixpence for them, and, fearful that his just rights and property in his dreams will be infringed, he carefully reserves the right of translating them. This is wrong. When a great prophet comes to give us "more light" (and we confess that we need it), he should rather encourage than repress those who would disseminate it.

But, to proceed—It was on a winter's evening, in December, 1866, that our author sat by the fire reading, to relax what he is pleased to term "his mind," which had been for several hours absorbed in "abstruse scientific speculations." The book that he read was George Henry Lewes's "Life of Goethe." As he read his last memorable words, "More light!" and pondered upon their depth of meaning, he fell asleep. What then happened he does not tell us; but a mysterious line of asterisks at once informs us that it was something very awful. Soon there appeared at his right hand a man, "beautiful of countenance." On his brow was a band, on which appeared, in sparkling gems, the name "Oriël," "Light of God;" and in his right hand he held a rod. Our author here pathetically tells us that he "trembled." This was but natural; he probably feared that Oriël was about to lay it on. Oriël, however (who, although a highly rectified spirit, appears to disagree with the stomach or brain of the eminently dyspeptic dreamer), bids him not be afraid, and, good-naturedly taking him by the hand, places him on a "Pinnacle of the Universe."

Oriël then tells him the destiny of the sun, and explains a few other astronomical phenomena, in language which shows distinctly that he has read Herschel's "Astronomy," and that his reading has been for edification. Our author (doubtless because Oriël has laid aside his rod) now not only ceases to "tremble," or to be "afraid," but even summons up courage enough to put a regular poser to Oriël in these startling words—"What is matter?" Oriël, evidently at a nonplus for the moment, does exactly what we all do under similar cir-

cumstances, and, instead of answering the question, proposes another, namely, "What is mind?" If our author had been sharp, here was a capital opportunity for a repartee. He should have answered "It is *no matter*;" but, instead of this, he somewhat feebly gives the views of Newton and Bishop Berkeley. Afterwards, feeling that he is expected to quote some more modern philosopher, he states "matter to be nothing but force, thus depriving it of that grossness generally supposed to belong to it." This, he says, "was the opinion of Faraday, who could not prove it, but yet believed it not impossible."

Poor Oriël, feeling himself unable to oppose the views of Faraday, without losing the confidence of our Dreamer, then states his own views to be the same. We would here most respectfully put the following difficulty which occurs to us, to Oriël. If you say that matter is force, we hope you will admit that force is matter; and, therefore, if, by out-flanking the question, in endeavouring to *take* grossness from matter, do you not at the same time *give* grossness to force? We do not insist upon this argument, because we feel, with Sir Roger de Coverley, "that much may be said on both sides."

Oriël then goes on to show our Dreamer (let us here confess that we had very nearly omitted the capital D) the "original element," and to prove that "this original element" is, "paradoxical as it may seem, *nothing*."

Up to this point we had travelled in all faith with our author; but when we find him gravely state that Oriël's next step was to make this "original element" (which he admits to be Nothing) revolve on its axis, we gave it up. We do not wonder, then, that after a few more feats, which Robert Houdin might have studied with advantage, our author says, "Despair took hold of me; my brain began to whirl, my feet to slip from under me, when—oh! relief!—I awoke; and it was a dream." At this point, we made a great discovery. "More light" is an allegory. Oriël means spirit; as we said before, highly rectified spirit; and thus we see that, under the influence of too strong a dose of "Oriël," we may expect our brains to whirl, and our feet to slip from under us.

Pharmacopœa Recentiores, Anglica, Gallica, Germanica, Helvetica, Russica, inter se collata. Scripsit, præfatus est et indicem triplicem adjecit, H. HAGER, Phil. Dr., Vratislaviæ. Günther, 1869.

THIS work will, undoubtedly, be appreciated by all really scientific medical men, as well as by pharmacutists everywhere, and Dr. Hager deserves the greatest possible credit, and the sincere thanks of the profession for this publication. As the title indicates, he has compared, *inter se*, the pharmacopœias recently published in Great Britain, France, Germany (not to be confused with the Pharmacopœa Borussica (Prussian), for the work here alluded to is in use in Central Germany, in dominions not as yet Prussianised), Switzerland, and, lastly, the immense Russian empire.

Throughout this work, the rule of most continental pharmacopœias, that weighing shall almost always be resorted to, instead of measuring, has been rigidly adhered to, and the measures of the British pharmacopœia have been reduced to weights as far as possible. The book is alphabetically arranged, and is, therefore, easy for reference.

Taking a couple of instances, almost at random, we observe, in the Russian codex only, a very excellent prescription for making magnesia sulphurea (sulfis magnesiæ), a salt now used internally in this country. The French codex has syrupus chinini sulphurici (sirop de sulfate de quinine), a useful preparation to give to young children, if required.

There are added to the work (1st) very useful tabulated forms, taken from the Swiss and German codices, wherein are indicated the single doses of the more active preparations and compounds, *above* which the substances named should not be dispensed, *unless* the medical man who pre-

scribes *distinctly* requires higher doses to be given; (2nd) indices for reference in the French, English, and Latin languages.

The book is well printed, in clear type, by M. Günther, at Breslau.

Labels for Chemical Substances. In paper wrapper, price 6d. London: John J. Griffin and Sons, 22, Garrick Street, W.C.

IN a recent number, we noticed several editions of chemical labels. We have since received another book, containing 195 labels, admirably arranged by A. VERNON HARCOURT, M.A., F.R.S., Secretary to the Chemical Society, and H. G. MADAN. The nomenclature is similar to that adopted in "Fownes" and "Roscoe." The labels for solutions contain an indication of the strength of the solution, and an explanation of the expressions used is also given. We are told that a book on laboratory practice, by the same authors, will shortly be issued.

CORRESPONDENCE.

EQUIVALENCE AND QUANTIVALENCE.

To the Editor of the Chemical News.

SIR,—No better proof can be wanted of the truth of Professor Williamson's remarks, upon the conflicting views held by chemists on the theories of equivalence and quantivalence, than a comparison of the opinions which those remarks have called forth.

Mr. Ward regards atomicity and quantivalence, equivalent and atomic weight, as synonymous terms. Mr. Orme describes the equivalent of an element as a varying quantity, from which the atomic weight is deduced by theoretical considerations, and from which it differs, being, of course, constant. Mr. Attfeld tells us that the term equivalent is correctly used with "distinct meanings," that the equivalents of Cl, O, N, C, are 1, 2, 3, 4, "in regard to the exchangeable values of atoms" but $35\frac{1}{2}$, 8, $4\frac{3}{4}$, 3, "in displacing one part by weight of hydrogen." "Chemicus" seems to follow Wurtz in considering the term equivalence a substitute for atomicity.

Doubtless these conflicting ideas would be reconciled, and much vagueness overcome, by accepting the definitions given by Mr. Ward, but unfortunately for our peace of mind, we cannot adopt them, unless we shut our eyes to chemical phenomena and our minds to the reasoning of not less able chemists. Equivalence may justly be considered *ponderal*, but equivalent weight can scarcely be taken as synonymous with atomic weight, as Mr. Ward seems to think. Let it be for a moment considered that atoms represent forces—as may be done upon the supposition that saturated compounds are in a state of equilibrium—then we may suppose that the atom of phosphorus in such a compound as the pentachloride (PCl_5) exerts a force five times as great as one atom of chlorine, consequently $\frac{3}{5}$ will represent a force equal to that exerted by 35.5 parts by weight of chlorine, and may reasonably be said to be equivalent to it. No such equivalent relation, however, exists between 1 part by weight of hydrogen and 16 of oxygen.

The numerical nature of quantivalence or atomicity is, of course, universally granted; a difference has, however, already arisen with regard to the use of these two terms, which Mr. Ward considers as synonymous. Naquet, in his excellent "Handbook of Chemistry," has preferred using the term atomicity for the maximum amount of saturation of which an element is capable, while he reserves the term quantivalence to express its varying saturating power. Thus he speaks of lead as being tetratomic, but forming

a series of compounds in which it is bivalent. If atoms represent forces, they must be definite forces, which sometimes become latent, and it seems desirable to have a special nomenclature by which the degree of latency may be expressed.

Since, then, the word atomicity is objected to by chemists (not, I think, without cause), and the expression quantivalence has a special significance, I would suggest that the term equivalent *number* be used to express the *fixed* saturating power of polyatomic bodies. If this course were adopted, we should speak of an element, such as phosphorus, as having for its

Atomic weight	31
Equivalent weight	$\frac{31}{5}$
Equivalent number	5

And as forming compounds, such as PCl_3 , in which it is trivalent, and others, such as PCl_5 , in which its quantivalence and equivalent number are the same.—I am, &c.,

C. H.

MISCELLANEOUS.

The Chemical Society, wishing to honour the memory of its late distinguished Fellow, Professor Faraday, and at the same time to promote the personal intercourse of the Society with eminent foreign chemists, has decided upon instituting a Faraday Medal, to be awarded, from time to time, to some foreign chemist of distinction, upon his accepting the invitation of the President and Council of the Chemical Society to deliver a lecture to its Fellows. The inaugural lecture will be delivered on June 17th by M. Dumas, Master of the French Mint; a personal friend of Professor Faraday's, and well known to chemists all over the world as the author of many important investigations in organic chemistry, and especially as the introducer of the doctrine of chlorine substitutions. By permission of the managers, M. Dumas's lecture will be delivered in the theatre of the Royal Institution, associated for so many years with Professor Faraday's own expositions. The Fellows of the Society and their friends will dine together at Willis's Rooms on June 18th, on which occasion M. Dumas is expected to be present as a guest.

Collodion for Protecting Silver Wares.—The loss of silver which results from the impregnation of our atmosphere with sulphur compounds, especially where gas is burned, is very great. It has been said that many thousands of pounds' worth go down our sewers annually in the form of dirt from plate cleaning, and the loss of one large house on Cornhill from this source has been described to us as serious. Silver-smiths may, then, thank one of their confraternity—Herr Strolberger, of Munich—for a happy thought. He seems to have tried various plans to save his silver, if possible. He covered his goods with a clear white varnish, but found that it soon turned yellow in the window, and spoilt the look of his wares. Then he tried water glass (solution of silicate of potash), but this did not answer. He tried some other solutions, to no purpose; but at last he hit upon the expedient of doing his goods over with a thin coating of collodion, which he finds to answer perfectly. No more loss of silver, and no longer incessant labour in keeping it clean. The plan he adopts is this:—He first warms the articles to be coated, and then pays them carefully over with a thinnish collodion diluted with alcohol, using a wide, soft brush for the purpose. Generally, he says, it is not advisable to do them over more than once. Silver goods, he tells us, protected in this way, have been exposed in his window more than a year, and are as bright as ever, while others unprotected have become perfectly black in a few months.—*Mechanic's Magazine*.

Depth of some Recently-Bored Wells.—As an evident proof of the greatly advanced desire to procure for domestic purposes good and pure water and a plentiful supply thereof, it is interesting to learn that within the last five years the undermentioned wells have been bored, some of them at very great expense. At Antwerp, to a depth of 165 metres below the surface; at Ostend, 300 metres; at Oeynhausen, Prussia, 696 metres; at Mondorff, Grand Duchy of Luxemburg, 730 metres; at Passy, Paris, 624 metres; at Rochefort, Charente Inférieure, France, 816 metres (this is the deepest bored well now existing in Europe). At Grisee, Soerabaya, Java, a well has been bored to a depth of 549 metres through hard rock. The deepest boring in Holland has been carried to a depth of 182 metres below sea level at Gorkum, at which depth in that locality, the tertiary formation has been reached, but water only of very indifferent quality; with this exception all the above-named wells yield water in abundance, and of great purity.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we are endeavouring to effect arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.

Annales des Mines, vol. 14, sixth series, No. 6.

The greater portion of this valuable periodical is filled with information of use only to the officials and officers of the Corps Impérial des Ingénieurs des Mines. We meet, however, with a large number of results of analyses of waters, among which is one, very recently made, by M. Pélégot, of—

The Water of the Grenelle Artesian Well.—The author calls attention to the remarkable fact that this water does not contain any dissolved oxygen, but only nitrogen, the quantity of which amounts to 14 c.c. to the litre of the water at 10° C. The total saline residue to the litre amounts to 0.142 grm.; the percentage composition of this saline matter is:—Carbonate of lime, 40.8; carbonate of magnesia, 11.5; carbonate of potassa, 14.4; carbonate of protoxide of iron, 2.2; sulphate of soda, 11.3; hyposulphite of soda, 6.4; chloride of sodium, 6.4; silica, 7.0. The same author has estimated the quantity, and determined the quality of the gases contained in rain water fallen and collected in the neighbourhood of Paris; 1 litre of this water gave off 23 c.c. of gas composed, in 100 parts, of 2.4 parts of carbonic acid; the remainder was a mixture of oxygen and nitrogen, in the proportion of 32 parts of the former to 68 of the latter. M. Stoelet has discovered that the water brought up from the coal-pits contains a greasy matter, soluble in ether, and no doubt derived from the coal; from his observations at and about collieries, he draws the conclusion that this greasy or fatty matter makes the water unsuitable, and, at times, even dangerous, for the use of steam boilers, since it may cause explosions.

It being impossible to quote all, or even the larger portion, of the results of mineral water analysis contained in the above-named periodical, we conclude this brief notice with—

Analysis of the Water of Villa Salice, near Voghéra, Piedmont.—M. Tissandier.—The dry residue for 1 litre weighs 65.532 grms., composed of—Chloride of sodium, 61.544 grms.; chloride of calcium, 1.031; iodide of magnesium, 1.338; sulphate of lime, 0.144; carbonate of lime, 0.811; carbonate of magnesia, 0.165; silica, alumina, oxide of iron, and organic matter, 0.499; total, 65.532 grms. This water is remarkable on account of the large quantity of iodine it contains.

This number of the *Annales* contains, moreover, a valuable collection of the results of recently-made analyses of minerals and rocks from divers parts of the globe.

Bulletin Mensuel de la Société Chimique de Paris, May, 1869.

This number opens with the *extraits des procès-verbaux des séances*, from which we abstract the following:—

Urea.—M. Bouchardat communicated that he had studied the conditions which accompany the production of urea by the action of ammonia upon chloroxycarbonic acid; besides urica, cyanic amides, melanuric acid, and other substances are formed. Hydrogen, in the nascent state, attacks nitrate of urea, thereby producing divers gases, consisting of hydrogen compounds, nitrogen, and carbonic acid. This reaction may be applied to the quantitative estimation of urea, by weighing the quantity of carbonic acid given off.

Oxysulphide of Carbon.—M. Ladenburg gave an oral account of his researches on oxysulphide of carbon. This substance, first obtained by M. Than, by means of the decomposition of sulphocyanate of potassium with dilute sulphuric acid, is also the product of the action of sulphuretted hydrogen upon cyanic ether, and of the action of heat upon thiocetic acid; it is also formed when sulphide of carbon acts upon urea.

Hydrates of Hydrocyanic Acid.—M. Gautier made a few observations on the question of the existence of well-defined hydrates of hydrocyanic acid. The experiments of MM. Bussy and Buignet, on the contraction of mixtures of water and hydrocyanic acid, led to a maximum contraction, corresponding to a mixture expressed by the formula $2\text{CNH} + 3\text{H}_2\text{O}$; if, M. Gautier says, there do exist hydrates, their fusing point must be constant. In order to test this, the author made several experiments on this subject, with mixtures made up of variable quantities of hydrocyanic acid and water taken in definite proportions; not one of these mixtures had a constant melting point (*point de fusion constant*). From his experiments, the author draws the conclusion that two definite hydrates may be said to exist expressed by the formulæ $\text{CNH}, \text{H}_2\text{O}$ and $\text{CNH}, 2\text{H}_2\text{O}$; these, by combining together, produce the hydrate $2\text{CNH}, 3\text{H}_2\text{O}$.

Iodide of Silicium.—M. Friedel made a brief communication relating to the iodide of silicium, Si_2I_6 , which is formed by the action of silver upon the tetraiodide. The first-mentioned substance is decomposed, by heat, into tetraiodide and diiodide; water decomposes this iodide, first forming an unstable hydrate, $\text{Si}_2(\text{OH})_6$, which is soon split up, giving rise to the formation of water and silici-oxalic acid, $\text{Si}_2\text{H}_2\text{O}_4$.

Vapour Density of Perchloride of Phosphorus.—M. Wurtz stated that he had repeated experiments on the vapour density of perchloride of phosphorus; his experiments have been conducted at a lower temperature than 160° C., and he has followed the process of Wanklyn, by causing the vapour of the perchloride to diffuse in a known bulk of air. The result of his (Wurtz's) experiments is that 7.2 expresses the vapour density of the perchloride of phosphorus.

The present number of the *Bulletin* contains the following original papers:—

Theory of the Carbides of Hydrogen.—M. Berthelot.—Too lengthy for abstraction.

Formation of Bromide of Acetylen.—M. Berthelot.—The author relates, somewhat circumstantially, how atmospheric influences affect the ready combination of those substances (bromine and acetylen) when in contact; bright sunlight appears to be an essential, but not an exclusive, condition. Since the absorption of acetylen by bromine does not always take place readily, Berthelot advises that when mixtures of gases containing acetylen have to be analysed, subchloride of copper should be used, when no gases but acetylen, absorbable by that substance, are present; subchloride of copper may also be applied as a qualitative test to ascertain whether or not acetylen, when present in a mixture of gases, is being absorbed by bromine, added to the mixture for that purpose. Fuming sulphuric acid was found always to act well, and its action is unaffected by light, a foggy day, or other atmospheric influence.

New Synthesis of Phenol.—M. Berthelot.—This paper is too abstruse for proper abstraction.

Oxidation of the Carbides of Hydrogen.—M. Berthelot.—The author finds that several carbides of hydrogen can be oxidised directly, and without loss of carbon, by the agency of chromic acid dissolved in a small quantity of water. Pure ethylen, free from vapour of ether, is slowly transformed, at a temperature of 120° C., into aldehyd. Propylen is far more readily oxidised, even at the ordinary temperature of the air, acetone being the result of the oxidation; amylene is very violently acted upon by chromic acid, so that no definite products are readily obtained; acetylen is converted into formic and carbonic acids.

Formation of Substances Homologous with Benzin by the Reciprocal Action of more simply composed Carbides taken in Free State, by M. Berthelot; **Pyrogenic Formation of the Acetylen of the Benzol Series,** by M. Berthelot; **Toluidine and Pseudotoluidine,** by M. Berthelot; **Researches on the Constitution of Toluene and the Alkaloids derived therefrom,** by M. Rosenstiehl; **New Mode of Preparing Allylic Alcohol,** by MM. Tollens and Henninger; **Bromide of Allyl and the Essential Oil of Mustard,** by M. B. Tollens; **Boiling Points of the Allylic Compounds,** by M. B. Tollens; **Electrolysis of Tartaric Acid and Tartrates,** by M. Edm. Bourgoin. These memoirs, evidently concisely written abstracts of longer papers, embodying an enormous mass of scientific research, cannot be properly abstracted, so as to do justice to the authors and their labours.

The remaining pages of this periodical are filled with abstracts taken from papers published in English, German, and French scientific journals, and also scientific books; but the contents of these abstracts are known to our readers, and are frequently taken from works published some years ago.

Journal für Gasbeleuchtung, April, 1869.

As may be inferred from its title, this periodical is more especially devoted to the interests of gas lighting; occasionally, however, it contains papers of interest to scientific readers, and when this is the case, as in the present instance, we shall make a brief abstract of such paper.

Influence of Heat upon the Regeneration of Sulphide of Iron.—It is well known that, according to theory, only oxide of iron and sulphur should result from the exposure to air of the oxide of iron applied for the purposes of purifying coal gas; in practice, however, it has been found that peroxide of iron, protoxide of iron, and sulphuric acid are also formed, but in variable quantities. Dr. A. Wagner has instituted a series of experiments, in order to ascertain the influence of heat and moisture upon the regeneration process. One sample of sulphide of iron, prepared by the moist way, was kept for three weeks at nearly 100° C., damp, and exposed to air; another portion was kept cold and damp, and exposed, for the same time as the foregoing, to air; while a third portion, under otherwise the same circumstances as No. 2, was kept dry. The result of these experiments is, that heat favours the production of sulphuric acid, while water or moisture does not exert any influence; that moisture and cold (ordinary temperature) produces less sulphuric acid than dryness and cold, since, in the former instance, the occasional watering with cold water, to keep the mass moist, favours a lowering of temperature which, when no moisture is present, is raised, in consequence of the chemical action; water is, however, absolutely required, in order to re-produce the peroxide of iron, since sample 3 was found to have been only very imperfectly converted into peroxide, more than half of the oxide being found as protoxide. The quantities, as deduced from the experiments, are the following:—Sample 1 (hot and moist)—Upon 1 part of S, 0.319 part

of SO_3 ; and upon 1 part of Fe_2O_3 , 0.1 part of FeO . Sample 2 (cold and moist)—Upon 1 part of S , 0.034 part of SO_3 ; and upon 1 part of Fe_2O_3 , 0.151 part of FeO . Sample 3 (cold and dry)—Upon 1 part of S , 0.085 part of SO_3 ; and upon 1 part of Fe_2O_3 , 0.5 part of FeO .

Moniteur Scientifique, No. 298, 1869.

This number does not contain any original articles; a portion of its pages are devoted to the description of the specification of patents, the subject matter of which is already known to our readers. Among the miscellaneous matter we observe the following:—

Improved Preparation of Neutral Acetate of Copper.—Five kilos. of sulphate of copper are ground to a fine powder; this having been done, the powder is placed in a suitable vessel, and 7.5 kilos. of liquid ammonia added thereto. After the solution is effected, 10 kilos. of acetic acid are added, and the vessel containing the copper solution placed on a water-bath; as soon as crystals are observed on the top of the liquid, the latter is strongly stirred, which promotes the formation of crystals. By this process, about 4 kilos. of neutral acetate of copper are obtained from the above quantity of sulphate, while the mother liquor yields some sub-acetate of copper afterwards.

Silicium contained in Aluminium.—It is well known that the aluminium of commerce is always contaminated with silicium and iron; a sample of aluminium recently analysed by Prof. Rammelsberg gave as much as 10.46 per cent of silicium, and another sample even 13.9 per cent. The quantity of iron varies from 2.94 to 7.5 per cent.

Silvering Cast-Iron.—M. Böttger recommends the use of a bath prepared in the following manner:—15 grms. of nitrate of silver are dissolved in 250 grms. of water, and 30 grms. of cyanide of potassium are added; when the solution is complete, the liquid is poured into 750 grms. of water wherein 15 grms. of common salt have been previously dissolved. The cast-iron intended to be silvered by this solution should, after having been well cleaned, be placed for a few minutes in a bath of nitric acid of 1.2 sp. gr., just previous to being placed in the silvering fluid.

Les Mondes, May 20, 1869.

We only notice the following from this paper:—MM. Wurtz, Bouchardat, Gübler, and Bergeron have been appointed to study the not altogether easy, but important question, Whether the addition of alcohol to wine, after its fermentation has entirely ceased, is injurious to the health of the consumer.

The title of the following work, from the eminent *savant's* well-known reputation, will not, we think, be unacceptable to many of our readers:—"L'Unité des Forces Physiques, Essai de Philosophie Naturelle," par le R. P. Secchi, Membre Correspondant de l'Institut de France, Directeur de l'Observatoire de Rome, Officier de la Légion d'Honneur, &c. Edition originale Française, grand 8vo., xx. and 700 pages; 56 woodcuts. Paris, 1869.

May 27, 1869.

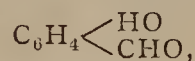
This number does not contain any original communications or papers.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 7, April 24, 1869.

This periodical contains the following original papers:—

On the Toluylen Group.—MM. Limpricht and Schwanert.—The authors begin this paper with an introduction, wherein they state that the reader of their present paper is referred back to memoirs of theirs published some years ago; next, they give a review of chief combinations of the toluylen group, being a series of some thirty chemical formulæ and names (too many to quote here); and they wind up with theoretical considerations on the relations existing between benzin, benzoin, toluol, benzil, and toluylen.

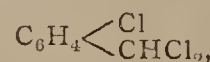
History of the Aldehyde of Salicyl.—M. L. Henry.—Since salicylic alcohol—



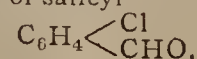
is an aldehyde, as well as a phenol, the author argues that it must be possible to obtain, from the salicylic alcohol, doubly chloruretted cresol, triply chloruretted toluol, and chloruretted aldehyde of salicyl. The author has succeeded in obtaining these compounds from the salicylic alcohol, and in this paper he describes, at length, the processes applied. Doubly-chloruretted cresol—



is a solid substance, crystallising in prisms, fusing at 82°C .; its alcoholic solution yields, with chloride of iron, a dark red colour. Triply-chloruretted toluol—



is an oily liquid insoluble in water; specific gravity, 1.4; boils at 227°C . Chloruretted aldehyde of salicyl—



is a colourless liquid, boiling at 210° .

Tension of Vapour, and Heat of Volatilisation of Chloride of Ammonium, by Aug. Horstman, and **Observations on the Aromatic Theory**, by A. Ladenburg, are both too abstruse for translation, an observation which equally applies to M. Buff's paper,

On the Doctrine of Affinity, a most erudite essay on a difficult subject. Next follow two papers, by two different authors, on the same subject:—C. Rammelsberg's essay, On the Formation of Periodates from Iodides, by means of Superoxides; and J. Philipp's paper, On the Formation of Periodates. Contributions to our Knowledge of Methyl-Aldehyde, by A. W. Hoffmann. All these papers being concisely-written and purposely-condensed abstracts made for this periodical, cannot be further condensed.

Polymeric Cyanobromide.—A. Eghis.—When freshly-prepared cyano-bromide is placed in a sealed tube, and exposed therein for from eight to ten hours, to a temperature of from 130° to 140°C ., the at first crystalline cyanobromide is converted into an amorphous, yellowish-coloured mass, this colouration being due to free bromine, while, at the same time, at the moment of the unsealing of the tube, cyanogen gas escapes. The author found that, with the product prepared in the manner just briefly described, he could not obtain the results he desired to have; he therefore placed freshly-prepared cyanobromide into anhydrous ether, and digested these substances for some time; he thus obtained a perfectly white amorphous powder, insoluble in benzol and absolute alcohol, and fusing at 300° . By analysis, this substance was proved to be a cyanobromide of the formula Cy_3Br_3 , containing 74.89 per cent of bromine.

Zeitschrift für Chemie, von Beilstein, No. 8, 1869.

There are no original articles contained in this number, which is entirely filled with translations, chiefly from French papers of older date, the contents of which have already been recorded in the CHEMICAL NEWS.

Comptes Rendus des Séances de l'Académie des Sciences, Monday, May 24, 1869 (No. 21).

Improvement of the Health of Workpeople, by an Improved System of Ventilation and Better Supply of Fresh Air to the Manufactories, illustrated by the good effects obtained at the Weaving Factory of Orival, near Lisieux.—General Morin.—Although, in the strictest sense, the subject matter of this paper does not belong to our department, we briefly notice that, in a factory wherein 400 people are daily employed, it becomes a matter of great importance to see to their health, especially in respect of fresh air. The General having been consulted on this subject by the owner of the factory, the former advised that at least 300 cubic metres per head, per hour, should be allowed for fresh air, provision being made to supply it so as to have a proper degree of moisture, as well as a proper degree of heat; into the minute details of the mode of supply, and carrying off the foul air, we do not enter, as this is a matter very much dependent on local conditions of buildings. The good results are proved by the fact (in this instance) that the yearly outlay for medicines had been reduced from 5,000, to less than so many hundreds of francs; while the consumption of bread had largely increased, as compared with the period previous to the making of the above-named improvements.

Distribution of Heat, and Work of the Induction Apparatus.—M. Le Roux.—This is a physico-mathematical essay, too abstruse for condensation.

Means of Ascertaining the Age of any Writing made with Ink containing an Iron Salt.—M. Carré.—The author states that, as long as writing is not very old, it admits of being copied, when moistened with water only, by means of the well-known copying press; further, that when writing has once attained a certain age, an alteration has taken place in the ink, which prevents the ordinary process of copying being successful; but, in that case, moistening with water acidulated with hydrochloric acid effectually aids the copying process. When, however, writing is some eighty years old, this contrivance also fails to aid the copying process; M. Carré found that writing, made in 1787, could not be reproduced by copying press, even when previously moistened with acidulated water.

Experiments on the Quantity of Mud and Slime carried down by Rivers.—M. Hervé-Mangon.—The author finds that the river Var carries from 9.15 to 36.61 grms. to the litre of water, of mud, amounting in one year, on an average, to 18,000,000 kilos., a quantity sufficient to raise a surface of 5,500 hectares (1 hectare = 2.471 acres), 20 centimetres in height. The rivers Marne and Seine carry down far smaller quantities of solid materials.

Second Note on Saturation, Surfusion, and Solution.—M. Dubrunfaut.—This is an abstract too concisely written and too long to admit of further condensation.

New Source of the First Terms of Acids belonging to the Fatty Acid Series, and especially on Propionic Acid.—M. Barré.—We hope to return to this paper, and give it in full, at a future time.

Climate of the Isthmus of Suez.—Referring to this subject, M. Le Verrier read an abstract of a letter from Prof. Buijs-Ballot, the Director of the Royal Netherlands Meteorological Institute at Utrecht, wherein that gentleman states that the draining of the Haarlem lake, in Holland, a surface of 19,000 hectares, has had the effect of increasing the average summer temperature of that locality, and adjacent country, by $\frac{1}{2}^\circ$, and of decreasing the average winter temperature, also, by $\frac{1}{2}^\circ\text{C}$.

Cosmos, 22nd livraison, May 29, 1869.

The present number of this periodical does not contain anything fit for abstraction for these columns, though, as usual, the periodical is very cosmopolitan and entertaining to general scientific readers.

Annalen der Chemie und Pharmacie, vi., Supplementband, Heft 3, 1868.

As usual, this supplement appears rather late in the present year. It contains the following original essays:—

Combinations of Phosphorus.—M. H. Wichelhaus.—The tendency of this essay, for it is that rather than a paper, may be inferred from the title and introduction, wherein the author says, "It is my aim to prove that it is unnecessary to assume anything else for phosphorus than triatomicity." The author, before entering upon his subject, discusses the word and meaning of quantivalence, and next writes an essay, filling some thirty closely-printed octavo pages, too concisely constructed for further abstraction.

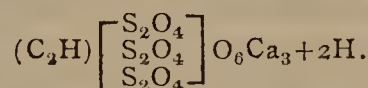
Isomerism of Bicarbonate of Ethylen and Ethyleniden, by M. H. Wichelhaus.—**Development of Heat of Chemical Reactions**, as dependent on the Change of the Number of the Molecules of Substances, by Dr. A. Naumann.—**Vapour Tension of Formiate of Ethyl and Acetate of Methyl**, by M. C. W. Dittmar.—**Relation Existing between the Chemical Composition of Arable Soil, and its Property of Yielding a Good Harvest**, by M. Schultze.—**Ammonium-Amalgam**, by M. Laudolt.—**Isomeric Derivatives of Allyl and Propylen**, by M. Alphonso Oppenheim.—**New Method of Formation of Resorcin**, by MM. Oppenheim and Vogt.

Journal fur Praktische Chemie, No. 4, 1869.

This periodical contains the following original papers:—

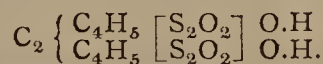
On Patellaric Acid, a New Lichen Acid, and its Existence in the *Parmelia scruposa*.—M. H. Weigelt.—The author has written a lengthy essay on this subject. Patellaric acid is a solid, exhibiting crystalline form and snow-white colour; its taste is exceedingly bitter; it is soluble in water, alcohol, and ether; and these solutions redden blue litmus paper. The percentage composition of this acid is:—C, 53.1; H, 5.2; O, 41.66. Space forbids us to quote any more from this paper, which contains the records of a long series of researches, not only on this acid, but on lichens generally, and the *Parmelia scruposa* especially.

Methintrisulphonic Acid.—M. Theilkuhl.—This acid is obtained when methyloxysulphate of lime is treated with a large excess of fuming sulphuric acid. The lime-salt of this new acid has the following percentage composition:—C, 3.62; H, 0.91; S, 29.00; Ca, 18.13; O, 48.34. The formula is:—

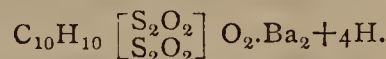


The author has also studied the baryta, potassa, and lead salts of this acid.

Amylendisulphinic Acid.—Dr. Ilse obtained this substance when he made sulphate of chloride of carbon, $C_2Cl_3(S_2O_4)Cl$, and zinc-ethyl act upon each other. The above-named acid has the following formula:—



The baryta salt of this acid is a crystalline solid mass, not readily decomposed spontaneously, of the following composition:—



It is soluble in water, difficultly soluble in alcohol.

Researches on the Influence which the Presence or Absence of Water Exerts in regard to the Vitality of the Yeast, or Ferment Cells.—Dr. J. Wiesner.

Ethylenchloride of Iron and Peruvian Balsam.—M. J. Kachler.—Ethylenchloride of iron, $C_2H_4.Fe_2Cl_3$, is formed when a solution of chloride of iron in ether is submitted to a high temperature in sealed glass tubes; it is a solid crystalline substance. As regards Peruvian balsam, the author states that it yields an excellent source of supply of pure benzilic alcohol. From 100 parts, by weight, of the balsam, he obtained 20 parts of benzilic alcohol, 46 parts of crude cinnamic acid, and 32 parts of resin, which, on being oxidised with potassa, yields benzoic and protocatechucic acids.

System of Elements, according to their Atomic Weights and Chemical Functions.—M. D. Mendeleeff.

NOTES ON LECTURE EXPERIMENTS.

Combustion of Sodium.—The metal sodium is stated not to take fire on cold water, but this is incorrect. A small piece of the metal will not do so, but a piece the size of a nut will frequently ignite; the flame may suddenly "pop" out, and it may as suddenly become ignited again. It is also addicted to the unpleasant habit of suddenly bursting into fragments, and throwing the fragments of metal in all directions. After the combustion of any considerable quantity of the sodium, it is curious to observe how the soda may be seen tinging with a yellow colour the non-luminous portion of any gas jet that may be burning. —G. N. M., Northampton, May 26, 1869.

PATENTS.

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1277. J. Scharr, Stuttgart, Wurtemberg, "Improvements in the manufacture of liquid soap."—Petition recorded April 24, 1869.

1391. C. D. Abel, Southampton Buildings, Chancery Lane, "Improvements in the treatment of cast-iron for the production of wrought-iron and steel therefrom."—A communication from W. M. Lyon, Pittsburgh, Penn., U.S.A.—May 6, 1869.

1409. F. C. Knowles, Lovell Hill, Berks, "A new or improved method of purifying and converting cast-iron into malleable iron or into steel, and for the making and use of materials and appliances for the same."

1413. E. Maybury, G. Matthews, and E. Marston, Pendleton, Lancashire, "Improvements in puddling furnaces."—May 8, 1869.

1414. R. Cadbury and G. Cadbury, Birmingham, and J. M. Rendall, Torquay, Devonshire, "A new or improved description of biscuit manufactured from the cacao bean."—Petition recorded May 8, 1869.

1418. H. R. Lumley, St. John's Wood, "The treatment of molten iron in order to free it from all impurities."

1419. H. A. Dufrené, Rue de la Fidélité, Paris, "Improvements in desiccating and preserving meat and other organic substances."—A communication from C. Tellier, Passy, Paris.

1426. W. E. Newton, Chancery Lane, "An improved process and composition for hardening common or grey cast-iron, and for converting articles of iron into steel, or imparting thereto a steely character."—A communication from B. W. Nichols, Canton, Ohio, U.S.A.

1431. H. Bessemer, Cannon Street, London, "Improvements in the manufacture of malleable iron and steel, and in furnaces and apparatus employed for their fusion and treatment."

1432. H. Bessemer, Cannon Street, London, "Improvements in the construction and mode of working furnaces and apparatus employed in fusing malleable or wrought-iron, and steel and pig, or other carburets of iron, and obtaining cast-steel, or homogeneous malleable iron therefrom."

1433. H. Bessemer, Cannon Street, London, "Improvements in the conversion of fluid crude iron and molten pig, or other carburets of iron, into fluid homogeneous malleable iron and steel, whether such pig, or other crude iron, is used alone, or is mixed with a portion of malleable, or more or less decarburised iron, in a solid or fluid state."

1434. H. Bessemer, Cannon Street, London, "Improvements in the treatment of crude, or pig-iron, and other carburets of iron, and in the apparatus employed for such purposes."—May 10, 1869.

1435. H. Bessemer, Cannon Street, London, "Improvements in the construction and mode of working blast furnaces employed for smelting the ores of iron, and in the mode of employing and utilising the gaseous products of such furnaces, and also in the construction and mode of working blast engines employed to force air into blast and other furnaces."—May 10, 1869.

1440. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved detergent, or saponaceous compound."—A communication from W. H. Newton, New York, U.S.A.—May 11, 1869.

1450. J. Robey, Newcastle-under-Lyme, "Improvements in sugar refining."

1458. P. W. Flower, Neath, Glamorganshire, H. Nash, Water Street, Liverpool, and R. Heathfield, Birmingham, "Improvements in coating sheets of metals with other metals."—May 12, 1869.

1464. E. V. Newton, Oxford Street, Middlesex, and P. M. Crane, Manchester, "A new or improved composition for coating ships, boats, and other surfaces, and for protecting and preventing the fouling thereof."

1469. J. Townsend and P. Forbes, Glasgow, N.B., "Improvements in refining or treating oils and fats, and in apparatus therefor."—May 13, 1869.

1483. G. Felix, H. J. Axel, F. Bang, F. Roch, C. Monestier, and J. P. A. Fignier, Paris, "An improvement in liquids for the lubrication of sheep's, or other wool, or other animal textile fibrous materials."

1486. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of beet-root and other pulps, and in the machinery or apparatus employed therein."—A communication from H. Champonnois, Paris.—May 14, 1869.

1493. L. A. V. Dubourg, M.D., Leicester Street, Leicester Square, Middlesex, "Improvements in the manufacture of gas for lighting and heating purposes, and in the apparatus employed therein."

1495. W. Wilkinson, Seymour Street, Euston Square, Middlesex, and M. Boss, Cleveland Street, Fitzroy Square, Middlesex, "Improvements in embossing, printing, enamelling, and ornamenting glass, metal, wood, canvas, or other woven prepared fabrics or other substances, and the preparation of the material, or materials and ingredients employed therein, and machinery or apparatus appertaining to a part thereof."—May 15, 1869.

1540. G. Martin, Dursley, Gloucestershire, "Improvements in the means of generating gases and chemical vapours employed in the manufacture of extract wool, and in destroying the vegetable material in mixed fabrics, and in the construction and arrangement of apparatus therefor, which apparatus is also applicable to other purposes."—May 19, 1869.

1562. J. McMillan, Dumbarton, N.B., and J. McGregor, Glasgow, N.B., "Improvements in the preservation of iron and steel, and structures composed thereof."

1568. G. Johnson, San Francisco, California, U.S.A., "Improvements in the distillation of spirituous liquors, and in apparatus to be employed therefor."—May 20, 1869.

NOTICES TO PROCEED.

3959. G. T. Bousfield, Brixton, Surrey, "Improvements in extracting the colouring matter of madder root from the ligneous matter of the plant."—A communication from A. Paraf, New York, U.S.A.—Petition recorded December 29, 1868.

18. H. A. Bonneville, Chaussée d'Antin, Paris, "Certain improvements in the process of refining iron and making steel, and in the apparatus used in carrying out said process."—A communication from C. J. Cainnon, Toulouse, France.—January 4, 1869.

12. K. Walter, Wicklow, "Improvements in the manufacture of sulphuric acid."—January 6, 1869.

62. W. T. Waite, Salisbury Square, London, "Improvements in the treatment of saccharine matters."—January 8, 1869.

98. C. J. Günther, Mark Lane, London, "Improvements in salting and preserving meat."—A communication from Baron J. von Liebig, Munich, Bavaria.—January 13, 1869.

230. A. V. Newton, Chancery Lane, "An improvement in fermenting substances and germinating grain and seeds."—A communication from R. d'Heureuse, San Francisco, California, U.S.A.—January 25, 1869.

1278. T. Forster, Streatham, and P. B. Cow, jun., Streatham Common, "Improvements in compounds containing india-rubber, gutta-percha, or ballata, and in the manufacture of such compounds."—April 24, 1869.

NOTES AND QUERIES.

Benzoic and Succinic Acids.—The commercial use of both these acids is very limited. Benzoin resin is used in perfumery, varnish making, and dyeing; in this latter operation both benzoic and succinic acids are also used and applied to a limited extent as mordants; beside this, both these acids are used in pharmacy, and, as is well known, applied in analytical chemistry, as ammonia salts chiefly; their high price would prevent their very extended use.

Mineralised Manure.—It appears from a short notice in *Les Mondes*, chiefly intended *pour prendre date*, that there has been found, in the Department of the Haute-Saône, near Lure, a layer of from 40 to 100 metres thickness of a mineral made up of from 3 to 4 per cent of bituminous oil, 2·8 of nitrate of ammonia, 5·8 of nitrate of potassa, 40 of carbonate of lime, 25 of gelatinous silica, 0·5 of oxide of iron, and 0·1 of sulphur. This mineral deposit appears to be the result of the slow decomposition of vegetable and animal matter, especially molluscs, belonging to a former period of animal life on our globe.

Water Saturated with Gypsum.—The result of the analysis, by Dr. F. Goppelsroeder, of a spring water found on the Dürenberg Estate, near Langenbruck in Silesia, gave for the saline matter found in 1000 c.c. of water:—1·636 grms. of anhydrous sulphate of lime, 0·185 of sulphate of magnesia, 0·019 of carbonate of lime, 0·024 of carbonate of magnesia, 0·008 of carbonate of protoxide of iron, 0·005 of silica, 0·06 of chlorine (combined with alkalis); moreover, small quantities of alumina, baryta, strontia, ammonia, phosphoric acid, nitric acid, and organic matter, which were not quantitatively determined. The solid residue of 1 litre of water, dried at 100° C., amounted to 2·503 grms.

Natural Water Containing Excess of Oxygen.—At Neubourg, Département de l'Eure, France, a spring of mineral water is found, from which a gas is constantly bubbling up and given off in large quantity, which, on analysis, proved to contain 44·6 per cent of oxygen, and 55·4 per cent of nitrogen; the gas causes, just as pure oxygen does, partly extinguished but yet glowing splints of wood to burst into flame. The analysis of the water proved it to contain in 4 litres the following quantities of saline constituents, expressed in gramme weight:—

	gram.
Chloride of potassium	0·0096
Phosphate of lime	0·0128
Alumina and peroxide of iron	0·0200
Silica	0·0140
Sulphate of lime	0·0348
Chloride of magnesium	0·0688
Nitrate of magnesia	0·0878
Carbonate of lime	0·7210

Free carbonic acid 0·9688
0·3284

—*Annuaire Pharmaceutique* for 1868.

Aniline Black.—The best kind of this dye is called in France, *Noir d'Anilin Lucas*; in England it is known as Petersen's aniline black; it is made, by a process kept secret, by M. F. Petersen, at St. Denis, near Paris. It is met with in commerce as a very deep black-coloured fluid, which, for the purposes of calico-printing and dyeing, has only to be thickened with starch paste, imparted to the tissue, and oxidised, to produce the finest deep black velvety-looking dye ever obtained. Among the very large number of prescriptions for manufacturing aniline black we notice Coupier's method, which is the following:—A mixture is made of 175 parts of nitrobenzin, 175 of aniline, 200 of commercial hydrochloric acid, 16 of iron turnings, and 2 of finely divided copper; this mixture is heated for from 6 to 8 hours at from 160° to 200° C., in an inside-enamelled iron-ware distilling apparatus. The operation is finished when a small portion of the mixture, having been previously removed from the apparatus and cooled, can be drawn into a tough thread-like mass, when rapidly

pulled between the fore-finger and thumb. The dye produced in this manner is soluble in acids, alcohol, and wood-spirit. When it is intended to apply this substance as a dye, it is dissolved in sulphuric acid, serving as a dye bath, after which the woven tissue, thread, or yarn, has to be bathed in a solution of either an alkali or hyposulphite of soda, in order to fully develop the black dye; without this precaution a black, verging upon violet or blue, is obtained.

Contraction of Caoutchouc by Heat.—It appears that M. Govi, at Turin, has repeated the well-known experiments of Joule and Thomson about the contraction which caoutchouc, after having been previously stretched out, undergoes when heat is applied. The author has found that this contraction only takes place within certain limits of temperature, and that, if a greater degree of heat be applied, the stretched-out caoutchouc, even though by no means exposed to a degree of heat which softens it to a pasty mass, expands and becomes rapidly longer. This substance, which has, in some aspects, puzzled philosophers, especially as regards some of its physical properties, has been frequently considered to consist of a kind of solid foam, made up of a large number of small vesicles filled with gas. This theory has been proved to be a reality, since Payen and others have seen these vesicles under the microscope, while M. Grovi has succeeded in expelling a portion of the gas from the vesicles by softening the caoutchouc, by means of oil of turpentine, and withdrawing, by means of the vacuum of the air-pump, the ordinary atmospheric pressure. This peculiar kind of constitution of the caoutchouc being admitted, it is easily seen that the vesicles, when that material is stretched, will lengthen in the direction of the stretching force, and contract—become more narrow—in the perpendicular direction to that force. When, under these conditions, the caoutchouc is heated, the gas within the vesicles, while expanding, will have a tendency to return to the spherical shape it possessed before being stretched, and this explains, therefore, the paradox of its becoming shorter while heated; in other words, contracting instead of expanding by heat.—*Les Mondes*.

MEETINGS FOR THE WEEK.

MONDAY, 7th.—Royal Institution, 2. General Monthly Meeting.

TUESDAY, 8th.—Photographic, 8.

WEDNESDAY, 9th.—Microscopical, 8.
Geological, 8.

THURSDAY, 10th.—Royal, 8.30.

Zoological, 8.

Royal Society Club, 6.

FRIDAY, 11th.—Astronomical, 8.

SATURDAY, 12th.—Royal Institution, 3. Mr. Deutsch, "On Semitic Culture."

TO CORRESPONDENTS.

*** We shall feel indebted to correspondents who will forward us Reports of Local Meetings of Societies, Chemical Appointments, and any other subjects interesting to the chemical world. We regret that, owing to the increasing popularity and circulation of the *CHEMICAL NEWS*, and consequent pressure on our space, we are often obliged to delay the publication of long papers. To those correspondents who wish to favour our readers with Notes of New Discoveries, Descriptions of Apparatus, or Answers to Questions, we would especially recommend our Notes and Queries columns.

E. K.—The lecture will be shortly published in our pages. Our publisher will write to you about the volumes of the *CHEMICAL NEWS*. The acid liquid is probably deliquesced phosphoric acid. We cannot vouch for the statements made by advertisers unless we have personally inspected the goods.

Tyro.—Add ammonium sulphide to the solution; collect, wash, and dry the precipitate, and fuse with a mixture of nitre and carbonate of soda.

H. Kelso.—The Adulteration of Food Bill, passed some years ago, is practically inoperative.

X. Q.—Cadmium amalgam is not at all brittle, but is tough, and highly malleable.

Messrs. J. B. and Co.—A letter is waiting for you at our office.

G. N. M.—There is no good description of the battery published. The manufacturer will give you any information you require.

Communications have been received from A. Voelcker; E. Kernan; C. Higgins, B.A.; P. M. Muir; S. Dunn; J. Davis (with enclosure); J. Pride; R. R. Tatlock; W. A. Todd; E. C. C. Stanford; F. A. Abel, F.R.S. (with enclosure); F. Jennings; R. D. Grindley; Mawson and Swan; A. Baxter; J. Heywood; Longmans and Co.; Dr. Rührig; J. Spiller; Dr. E. Fleischer (Dresden); J. Hughes; E. H. von Baumhauer; G. Pearson; H. Yeates; C. Tomlinson, F.R.S.; B. Quaritch; Dr. Adriani; The Royal Institution; E. P. H. Vaughan; A. Clarke; and S. W. Rich.

BOOKS RECEIVED.

Spectrum Analysis; Six Lectures delivered in 1868 before the Society of Apothecaries of London. By Henry E. Roscoe, B.A., Ph.D., F.R.S. With appendices, coloured plates, and illustrations. London: Macmillan and Co.

Archives Néerlandaises des Sciences Exactes et Naturelles, Publiées par La Société Hollandaise des Sciences à Harlem, et Rédigées par E. H. von Baumhauer. La Haye: Martinus Nijhoff. Londres: Trübner and Co.; Williams and Norgate.

THE CHEMICAL NEWS.

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CHEMICAL EXAMINATION OF THE ORIENTAL JARGON.*

By DAVID FORBES, F.R.S., &c.

A SHORT time back, I undertook, at the request of Mr. Sorby, to prepare for him some of the earth or earths which, in combination with silicic acid, formed this gem, and as the means I employed in so doing appeared to throw some little light upon the characters of the earth hitherto regarded as zirconia, I have thought that a notice of the results obtained by me might not be devoid of interest.

The jargon employed was in fragments, being part of an almost colourless crystal, forwarded to me by Mr. Sorby, who had previously found, by optical examination, that it showed with great distinctness the peculiar and characteristic spectrum which he ascribes to the presence of the new element jargonium, and noticed that the bands became much more pronounced after ignition and cooling.

The fragments, which were extremely hard, were broken up in a diamond mortar, previous to being reduced to as impalpably fine a powder as possible in an agate mortar; 16.22 grains of this powder were then thoroughly mixed with 81 grains pure anhydrous carbonate of soda, placed in a platinum crucible, and fused at the highest heat of a large air gas blowpipe jet, after having been previously kept for two hours over a powerful Bunsen's flame, so as to "frit it," or ensure combination previous to fusion. After complete fusion, a small lump of pure hydrate of soda (about 15 grains) was, as recommended by Berzelius, carefully deposited in the centre of the fused mass, and a second similar piece added after the first had been absorbed; the fused substance became much more liquid after this addition; the heat was kept up for another half hour longer, and the whole was allowed to cool.

By the above means the mineral was perfectly decomposed, and the silica so altogether transferred to the soda that it could be completely removed by cold water, leaving no trace behind with the earths. Previous experience with the zircons from various localities, and hyacinths from Ceylon, had proved to me that the perfect decomposition of these minerals is often attended with considerable difficulty.

The fused mass when cold was treated repeatedly with cold water in a silver vessel, decanting off the supernatant solution each time, until the silica was entirely removed, and a white powder, probably a compound of the earth with soda, remained behind.

The solution which contained all the silica was acidified with hydrochloric acid, evaporated to dryness, and the silica determined as usual. The silica obtained weighed 5.45 grains, consequently was equivalent to 33.61 per cent in the mineral.

The white insoluble residue previously mentioned, was found to be perfectly soluble in hydrochloric acid; in order to test if it contained any silica, the solution was evaporated to dryness and re-dissolved in water acidulated by HCl, but left no trace of insoluble matter behind. From the colour of the solution being distinctly yellow, it evidently contained oxide of iron, which I had scarcely expected, since the original mineral was nearly, if not

altogether, devoid of colour; the solution, consequently, was a chloride of the earths of the jargon, accompanied by some sesquichloride of iron.

Berzelius many years ago devised a means of separating oxide of iron from zirconia, founded upon the behaviour of their respective chlorides, the sesquichloride of iron being soluble in strong hydrochloric acid, whilst that of zirconia is nearly insoluble; I had tried this process previously with zirconia from Ceylon hyacinths, and had not been satisfied with it, as the iron solution carried along with it a not inconsiderable portion of the earth. It now struck me, however, that possibly the earth so dissolved might differ in character from that contained in the insoluble chloride, and I therefore determined to make the experiment.

The hydrochloric acid solution was consequently again evaporated until it solidified as a yellow saline mass, whereupon it was treated repeatedly with cold strong hydrochloric acid of density 1.138, allowing it to stand some time and decanting the solution as long as the fresh acid acquired the faintest yellow tinge. A yellow solution was obtained, leaving behind a snow white chloride, crystalline in appearance and completely soluble in water, forming a perfectly colourless solution. From this solution ammonia precipitated a flocky, but apparently rather dense, white precipitate, which, after being thoroughly washed, dried, and ignited, was of a pure white colour and possessed a peculiar waxy look and dense appearance; it weighed 7.48 grains, and consequently amounted to 46.12 per cent of the jargon examined.

This earth was examined optically by Mr. Sorby, and, according to his account, did not give a trace of the characteristic jargonium bands in the spectrum, and it was, therefore, concluded to be pure zirconia.

The yellow hydrochloric acid solution was now examined, and found, besides sesquioxide of iron, to contain a considerable amount of an earthy base, like zirconia. I decided to separate the iron by the tartaric acid and sulphide of ammonia process recommended by Berzelius, and, consequently, the solution was first supersaturated by ammonia, which threw down a faint yellowish white somewhat flocculent precipitate. Tartaric acid in excess was then added, which dissolved at once the greater part of the precipitate, but, notwithstanding that a very large excess was added, a portion of the precipitate refused obstinately to re-dissolve, even upon application of heat. In order to examine this, the solution was filtered: a white, flocculent, and somewhat glutinous substance was left upon the filter, which, when well washed with hot water, dried, and ignited, weighed 1.24 grains, equivalent to 7.64 per cent of the original mineral.

This body, after ignition, appeared very different from the previously-obtained zirconia; it was a white powder, but did not aggregate together or form lumps having a waxy lustre on the surfaces of fracture; on the contrary, it was more pulverulent, had a dead white, or mealy, appearance, and did not appear to be of any great density.

From Mr. Sorby I learn that it gave the spectrum of jargonium with intensity, and he concludes that it must probably be its pure oxide or jargonite.

Ammonia was now added in excess to the tartaric acid solution, which remained clear. Upon the further addition of sulphide of ammonium, the solution assumed a dark brown coloration; but no precipitate separated before the lapse of some days, when a black deposit of sulphide of iron formed, which was collected upon a filter, after the greater part of the supernatant liquid had been carefully syphoned off.

This sulphide of iron was converted into sesquioxide, and afforded 0.04 grain, equivalent to 0.24 per cent in the mineral.

After separation of the iron, the solution was evaporated to dryness in a platinum capsule, and ignited for some time, to drive off all ammoniacal salts, and oxidise the carbon resulting from the decomposition of the tartaric acid. There then remained behind an earthy body, of a

* Although in commerce this mineral is generally known as the jargon from Ceylon, the name Oriental jargon seems to me to be preferable, since it appears uncertain whether these stones are actually found in the Island of Ceylon, that place being well-known as the principal Eastern mart for precious stones procured on the mainland of India and the adjacent countries.

white colour, having a slight tinge of grey, which weighed 2.03 grains, or 12.52 per cent.

In appearance, this earth was quite different from the zirconia, and more resembled that supposed to be jargon. Mr. Sorby, upon optical examination, reports that "It seems to contain a good deal of zirconia and a very decided trace of jargon, but I am very much inclined to suspect that it may contain some other substance. Its behaviour with borax before the blowpipe is very different from that of the zirconia from the jargon, and it turns extremely opaque, and a sort of orange-yellow, by transmitted light." Possibly this substance may contain a third earth analogous to zirconia, such as Svanberg (*Ofversigt. Kongl. Vet. Acad.*, pp. 34, 37, 1845) suggested was present in eudialite and certain zircons.

The result of this examination of the jargon, when summed up, indicates its composition to be as follows:—

	In 16.22 grains.	In percentage.
Silica	5.45	33.61
Zirconia α	7.48	46.12
„ β (jargon?)	1.24	7.64
„ γ	2.03	12.52
Sesquioxide of iron	0.04	0.24
	16.24	100.13

The formula ZrO_2SiO_2 ascribed to zircon requires—

Silicic acid	33.77
Zirconia	66.23
	100.00

with which the numbers found for jargon are closely approximative.

The results of this chemical examination must be considered as strengthening the evidence, physical and chemical, that the earth usually denominated zirconia is, in reality, a compound of two, if not more, closely-allied oxides. In 1845, Svanberg announced that the zirconia contained in the various zircons from Siberia, Norway, and Ceylon, as, also, in the hyacinths from Expailly and Ceylon, was a compound of two or more earths, one of which he termed *noria*; and, in a subsequent paper the same year, also found this to be the case with the earth in the Greenland eudialite. His arguments—for he did not succeed in separating the earths—were founded upon his observations that the salts of zirconia did not always contain the same constant proportion of acid to base; that the oxalates, chlorides, and sulphates differed in their behaviour and solubility in certain reagents, and that the specific gravities of the natural silicates (zircon) from various localities differed greatly from one another.

These observations of Svanberg, notwithstanding the promise contained in his short paper on the subject to bring forward fuller evidence, have, as yet, never been followed up by him, and the subsequent researches of other chemists appear to throw doubt as to their correctness in several points, as well as to render the existence of his *noria* extremely dubious. The researches of Berlin (*Fourn. f. Prak. Chemic*, lviii., p. 145, 1853) showed that the results of the fractional precipitation of chloride of zirconia by oxalic acid did not warrant the conclusions of Svanberg, and that the zirconia prepared from zircons from Frederiksvaern, Expailly, Ural, India, and from the Ceylon hyacinths and Norwegian katapleite, behaved in similar manner with oxalic acid, and that their oxalates were easily and completely soluble in excess of that acid, and that the specific gravity and amount of zirconia obtained from the oxalates from Frederiksvaern zircon and katapleite which he examined were identical, so that it would seem necessary to seek for some other means of separating the earths than by the employment of oxalic acid. In some experiments I made for the purpose of attempting to isolate *noria* (in which I used Norwegian zircons from two different localities, and also hyacinth from Ceylon), I failed in so doing, but corroborated the results obtained by Berlin.

In 1864, Nylander, in a paper, "Bidrag til Kännedomen om Zirkonjörd" (*Acta Universitatis Lundensis*, 1864), has examined the zirconia from the Norwegian eucolite, and considers that it contains two earths, which differ in their behaviour and solubility of their double potassium sulphate salts, but he also appears to have come to no definite results as to the existence or isolation of the earths themselves.

It is to be hoped, however, that the interest now excited by Mr. Sorby's announcement of the existence of jargonium will induce chemists to work the subject out in more detail.

ON THE EXAMINATION OF WATER FOR ORGANIC MATTER.*

By R. ANGUS SMITH, Ph.D., F.R.S., &c.

IN 1865 I received a request to write on the organic matter of water. I wrote a memoir, which was, without intending to be published, extensively circulated among officers of health, especially in India.

I there made a division which was entirely new to chemists. The substance styled "organic matter," instead of being given as one to which little or no definite meaning was attached, was considered as existing chemically under at least seven different headings, not forgetting the numerous organised forms which it might assume. These divisions were—

- 1st. The organic matter decomposed, or putrid.
- 2nd. Organic matter readily decomposed, and probably ready to become putrid.
- 3rd. Organic matter slow to decompose.
- 4th. Recent organic matter.
- 5th. Old organic matter.
- 6th. Vegetable organic matter.
- 7th. Animal organic matter.

The first was known by the gases which instantly decomposed permanganate.

The use of the permanganate of potash, recommended by Forchhammer for ascertaining the organic matter of water, has been tried and admired by some, and found entirely wanting by others.

I endeavoured to show, in the memoir alluded to and in a subsequent paper, how far that salt could be trusted; quite certain of its value for ascertaining bodies of the first and second classes, but having no experience of my own which would guide me to consider it a sufficient test for the total quantity of organic matter.

Bodies of the third class I was therefore inclined to estimate quantitatively by drying and weighing, afterwards ascertaining the condition of the matter as the point of most importance.

Organic matter of the fourth class was estimated by the amount of nitrites in the water, because their existence showed that the matter was oxidising, but had not had time to complete the action.

Bodies of the fifth class were estimated from the nitrates, as in that case the action was finished.

Bodies of the sixth class were reckoned from the absence of bodies of the seventh class, which latter class, again, were considered to exist when they were accompanied by an unusual amount of chlorides, supposing care to be taken to discover that other sources of chlorides did not exist.

It is not to be expected that any of these divisions should be sharply defined; but the one most difficult to decide upon, to all appearance, is really that which I have found, with proper precautions, scarcely ever to fail me, though

* From vol. iv., 3rd series, of the *Memoirs of the Literary and Philosophical Society of Manchester*. (Communicated, with emendations and alterations by the author).

it has been used in hundreds of instances, and for many years—namely, the test for animal matter.

Dr. Woods had written on the use of Forchhammer's chameleon previous to the publication alluded to, and about the same time Prof. W. A. Miller; but I am not aware that any one endeavoured to distinguish the various conditions of the organic matter. I am, and was, desirous of showing that organic matter is not necessarily hurtful; we speak of it in water as an evil, to be measured by the balance, whilst there is as much difference in the qualities of that found in water as there is between good wholesome meat and putrid flesh.

I was desirous also of showing the true value of the permanganate, which is capable of acting on one, but scarcely on the other, and of being used for analysis for sanitary purposes, although not for all the demands of the chemist.

Dr. Frankland next took up the subject, and proceeded to show the amount of organic matter, or of sewage matter, which might flow into a stream; and this he did by estimating the nitrogen gas obtainable from the organic matter of the water. By ascertaining the amounts existing in the water supplied to a town and flowing in the sewage, he found the total thrown out by the inhabitants.

For this he made an organic analysis of the residue of the water, and by a very beautiful arrangement, using Sprengel's pump, he drew out the nitrogen for measurement. I do not doubt that this mode adopted by Dr. Frankland will always be useful, and will remain permanent as a method, but not for constant use, on account of the time required, excepting by those chemists who perform many of such analyses, and have the apparatus in constant readiness. It is, however, always pleasant to find an addition made to our capacity for accuracy, and especially when such beautiful methods are employed.

By this means Dr. Frankland obtains the organic nitrogen, nitrates and ammonia being removable. I have not generally estimated the latter, as being still more unstable than the former, and I have frequently found it to disappear with great rapidity, affording by no remnant any clue to the past. Urea and uric acid must also be excluded from the organic nitrogen before we obtain a clue to the albuminous matter. I think, however, that we require to know, above all, whether this matter is in a state to putrefy, or to produce living forms. If there are organic germs capable of development in a visible form, that condition ought not to be neglected.

Immediately, I believe, after this plan was adopted by Dr. Frankland, Mr. Wanklyn discovered a mode of decomposing albumen by permanganate of potash, obtaining ammonia.

This process was used by Messrs. Chapman and Miles Smith. I shall not attempt here to give the exact amount of honour due to those gentlemen, or to tell precisely the boundaries of their labour.

The result seems to be, that the nitrogen may be obtained without the trouble of the usual organic analysis, although it may be uncertain which process takes the longest time.

Mr. Wanklyn considers that he can, by his method, first remove the ammonia which exists as such, by boiling with carbonate of soda; next, by decomposing the albumen with permanganate of potash and boiling in caustic potash, obtain the ammonia resulting from the decomposition. This is a decided gain to us, and may turn out to be the normal mode of separating the ammonia of the putrescible and unputrescible organic bodies.

We are rather apt, when we find a method of analysis, to look at it as final. I shall endeavour to show how much we obtain by Dr. Frankland's method, and how much by Professor Wanklyn's. I shall perhaps, also, as in such cases, be inclined to show that my own method reveals a greater amount of the peculiarities of water. It makes more divisions, is more complicated therefore in one respect; but every point tells its own tale, and it is the number of tales we have to tell regarding the history

of water that measures the fulness of our reports. I shall probably adopt all the methods for a time.

In the paper mentioned, I pointed out the error of supposing that organic matter was all equally unwholesome, or that it was, in all cases, even in the slightest degree so. It was the custom too much to confound the simplest peaty and the most noxious putrescible matter. On this subject I may here quote the paper.

"Quality of the Organic Matter."

"Water manifestly containing organised matter is to be avoided; but it may frequently be purified by some mechanical mode of separation, such as simple straining.

"If the water contains organic matter in solution, or a condition approaching in all appearance to solution, it may be wholesome or unwholesome. The mere existence of organic matter is no proof of impurity. We must know if it brings animalculæ or vegetable life or products of putrefaction. We must know the *quality* as well as the quantity. If the matter is peaty, consisting of the ordinary humous class of acids and salts, the colour may be very dark and the water very unpleasant to look at, without being in any way, so far as I have ever heard, injurious to health, although such water cannot be quite so wholesome as pure water, since the oxygen of solution is diminished. The taste and other sensible qualities will be the chief guides.

"If the matter is wholly or nearly colourless, it may still be wholesome or unwholesome. It may, for example, contain the juices of plants of a wholesome character. If these juices are fresh, they may do no injury; but they will not long remain fresh, they will putrefy. Water containing organic matter ready to putrefy ought to be avoided, as we cannot tell when the moment of danger begins; whilst the quality at best is never known to us exactly.

"To ascertain the nature of the organic matter, the water is allowed to stand for a day or two, in which case it may be found that organised bodies show themselves.

"Sometimes plants seem completely to fill the vessel, having come out of a moderately clear solution. When standing, in this case, the water must be prevented from evaporating, and it must be in glass, so as to be exposed to light; a temperature suiting vegetation is also to be given. Animalculæ may appear in great numbers; they are an indication of nitrogenous matter, and one proof of the presence of substances capable of putrefaction. It may be that some form of putrefaction will be the only result; but whether this occurs alone, or along with organised forms, an excess of organic matter is proved.

"Water that will not bear the test of standing will in most cases be rejected at once. If no other can be obtained, it ought to be used before the putrefactive process has begun; but this is very dangerous. The next best method is to wait till after putrefaction has terminated, and the products are separated as much as possible. This is popularly known to be the case when the water has for some time become clear and colourless, and free from smell and taste. There are some difficulties connected with this. Water undergoing putrefaction is manifestly unwholesome. After putrefaction is completed, it may be quite wholesome. Although the process is proved by Pasteur not to begin without the aid of organic germs of some kind, they seem to be of a class constantly existing in the atmosphere, even when it is wholesome, whilst we have reason to believe, from the results, that germs of disease, if there are such, are decomposed, like other albumenoid substances, during the action. It would, therefore, be probably safer to wait till putrefaction was completed, but this is often tedious. At any rate, it was intended to state that, when activity began, it was not safe to use the water. The points of safety and of danger require investigation.

"Water with green organic matter in suspension or semi-solution is generally full of germs of living things, and nauseous to the taste.

"A microscope is very useful in detecting the smaller forms of life, but not always essential. Good water is clear and colourless, or only slightly browned by peat. Clear bright water shows no microscopic objects. It is quite a mistake to suppose that all water contains animalculæ. Those who have sent abroad this saying could not have known what pure water is.

"If the signs of organic matter are clear, it may not be needful to go further, but to reject the water at once. After standing for two or three days, varying with temperature, and showing nothing to the eye except a little film of green on the bottom of the vessel, we may conclude that not much organisable matter is there. We may then proceed to the chemical examination."

Some years ago it was customary, more than now, to examine with the microscope water intended for the use of towns. Attempting at one time to join the chemical and microscopic together, as they were too much in separate hands, I came to certain general conclusions:—That no ordinary pure water produced much vegetable or animal life, and that microscopists were mistaken in allowing people to suppose that every drop of water was inhabited; that nevertheless water, generally considered very pure for drinking, might contain some forms not possessed with distinct locomotion; that whenever distinct locomotion began, especially among soft-bodied forms, the water was more than suspicious; that forms increased with the quantity of organic matter containing nitrogen, until the amount was so great as to cause gases of decomposition which eventually stifled life. How far this stifling of life proceeds I do not attempt to say. I suppose it will not apply to the mucedines, which cause putrefaction to commence.

If the water was impregnated with sewage water (as the Thames at London, for example), bad cases excepted, the amount of vegetation which spread over the sides of a bottle filled with it and set in the sun, was so great as to give the appearance of one solid mass. If the water were taken from the river above Reading, the amount of vegetable matter was seen as a delicate green colouring at the bottom of the vessel; and if it were taken up at the source, no greenness whatever appeared, but, after long standing, minute crystals of limestone. If the water contained sewage, the phosphates and magnesia were generally found collected in some form of the *Navicula*, frequently in large groups of the *Navicula fulva*, and with it also was found phosphoric acid and magnesia. It was sufficient to note the condition of the water with relation to these deposits to ascertain at what part of the Thames the specimen was taken; and without the examination of these deposits, I do not consider that it would have been possible to obtain a distinct idea of the nature of the organic matter present. It is, however, needful that we know the general character of the water; had we a specimen from another situation and found no deposit whatever, it would have been very unfair or very unwise to conclude that it was similar in quality to that from the source of the Thames. It might have been saturated with nitrates, and even a large amount of organic matter not capable of taking the forms alluded to. Perhaps, however, nitrates prevent decay in water as in meat. As the germs of the lower forms of life may pass by us unobserved, it is necessary that we should give them time for development, in order that they may become sufficiently prominent to attract our attention. For this reason I consider it an imperfect examination of water when this is not attended to, in cases at least where we have not the slightest idea of the nature of the water. We find water with less than two grains of organic matter per gallon giving rise to forms by no means agreeable to look at in our food, and water with several grains of organic matter giving rise to no such forms.

It is true that we cannot tell which of these living forms are most dangerous; we cannot tell which of them, if any of them, produce either cholera or any other disease; but we can say that water which contains them may contain the elements of disease, whilst water which does not

contain them or matter to make them is innocent. So far as this we are obliged to go at present. It was for these reasons that I have not recommended the method of estimating the total nitrogen in water. I was inclined to believe that the danger arising from water could not be measured by the amount of organic matter, or even by the amount of nitrogen in the organic matter.

Still it is of advantage to estimate the nitrogen of the organic matter, in order to compare the state of one source of water from day to day, as, for example, Dr. Frankland does so frequently in the case of the Thames. It is not, however, the organic matter only that gives out nitrogen; that is given out by ammonia and nitric acid; and these must also be estimated when seeking albumenoids. And this course is adopted by Profs. Frankland and Wanklyn.

We may now inquire how far all these bodies together will give us the amount of the organic matter falling into the water.

When azotised compounds decompose and form ammonia, how long is this ammonia retained in the water? On examining a very putrid stream, I estimated the amount of ammonia at the most putrid portion, where carburetted hydrogen was passing off in great volumes, and where a cubic foot could be obtained in a very few minutes by stirring.

In the sewage stream of which I have spoken, the amount of ammonia was from 0.5 to 0.7 grain per gallon. After going 14 miles, the amount was only 0.07, and, after 20 miles, none at all was found. To say none at all, is to go far, but it was not found by the mode adopted for the others.

The mud of the same stream was in a state of putrefaction, and contained, per cent—

Ammonia	.. .. .	0.797
„ a mile lower	.. .. .	0.420
„ at second mile	.. .. .	0.171

The ammonia rapidly disappeared, and the mud itself diminished very greatly in amount.

I estimated that one grain of ammonia evaporated, in some seasons, from every square foot per hour.

In taking sewage water to the land, I think it very important that the movement should be as rapid as possible.

The water, in its passage of 20 miles, has lost its valuable ammonia, and that within two or three days. This is a sufficient proof that we must not trust to the ammonia as an indication of the amount of the organic matter which has been present, as it is as rapidly removed as the organic matter is decomposed; that is to say, the length of time necessary for complete putrefaction is, under favourable circumstances, no greater than the time afterwards required for the removal of its products. In enquiries on putrefaction, I have found the temperature 12.2° C. a marked one. Putrefaction may be said to begin actively at that point, and the results here given would, probably, be very different below that. In this water there was no moving life to be observed; but the estimation of the organic matter would have shown no difference, whether vitality had been present, and the substance had been capable of entering into active and unwholesome forms, or had been ready to break up into instantaneous putrefaction, or had been preserved, like a mummy, in carbolic acid for a thousand years.

From this observation regarding the ammonia, we are clearly led to beware, in our schemes of irrigation by sewage water, that the land shall be overflowed before the ammonia is thoroughly formed, or else, if the ammonia is formed, that it shall not be subjected to loss by long exposure to evaporation.

We see, also, that nature provides here for the complete obliteration of organic matter. It ceases altogether to be found in the water. It may be traced, either as such, or as ammonia and carbonic acid, long after the bubbles of carburetted hydrogen have ceased to appear, until, at last, it dwindles down to an amount which is rather difficult to remove from water, and which, so far as we know, may be utterly disregarded.

In the passage of organic matter, we may observe, from figures soon to be quoted, that the volatile and organic matter diminished from 9.33 grains per gallon down to 5.04, even when there was an increase of fixed matter, and that the decomposing matter in solution diminished still more rapidly, in the ratio of 283 to 17. The use of the word decomposing matter is not quite correct; it means the substances in solution, arising from decomposing matter and absorbing oxygen at once. It must be observed that the time required was two to three days; and I may add that I could not have drunk the water at last, but there was great foulness to begin with. Still, it shows great removal of impurity.

The organic matter having left the water, we may next enquire whether any trace of its existence remains behind. That trace we do find in the increased amount of alkalies, sulphates, and chlorides.

The alkalies and alkaline salts, but especially common salt, are prominent. The whole of the common salt which has been used as food, without the slightest loss, is found in water, when vegetation has not removed it. The sulphur has become partly oxidised, leaving sulphates, whilst some may have left in company with hydrogen. Phosphates have been increased for a time; but they rapidly fall, taking lime and some magnesia with them; and, on the whole, the great change to be observed in the water is connected chiefly with the alkaline salts. The most stable and most constant of these, without loss, is common salt.

On this subject, I may quote what has been said elsewhere regarding the chlorides as an indication of the presence of animal matter, proper regard being had to the absence of other sources, which, in this country, are chiefly connected with artificial circumstances. "The absence of the chlorides, especially, may be considered as the certain absence of sewage matter, and their amount to be estimated as an indication of the comparative amount of sewage matter from day to day, in cases where sewage only pollutes the river." I conclude from these data that the organic matter and the nitrogen in it are equally incapable of giving us a sufficient history of the water. We may draw another conclusion, that nature has provided a mode in certain conditions for its perfect removal.

It is worth while to ask whether this purification by putrefaction is not the most complete method; it seems to destroy that which we consider to be germs, which germs may be a beginning of any disease of the most terrible form. Having read most that I can find on this subject, I have been led to think that the water, before and during putrefaction, may contain the diseases that have been washed from cities, but that the air above, containing the gases and vapours, does not contain the germs of these diseases, although, of itself, it is extremely loathsome and decidedly unwholesome. It is rapidly purified by the atmosphere. However, I reason from the facts obtained by others, since disease is not my study. After complete putrefaction and clearing, the water seems to be used with impunity. Our rivers, however, seem too small to purify large quantities in their course, as, even in warm weather, the time must be measured by days if the specimen given is a fair one. I do not pretend to say how much may be allowed to go into a river of a given size without fear, but this may be found, as, after all, every river has some sewage from animals, and, in this country, even from man also.

If the water were allowed to clear itself by standing, producing whatever amount of organic life could be developed from it, the germs might be increased in number, instead of being diminished. It is proper to observe that the liquids must be included. The solids contain little chlorine. The water above might remain very clear, but might be, nevertheless, very dangerous. In such a condition, water seems to be best purified by filtration through the soil, which simply means extremely slow and careful filtration, accompanied with partial oxidation; in that case, the water coming from under the soil would be fit

again for use, although it would contain, and does contain, the alkaline salts alluded to.

Waters from rich lands, unless from very deep drains, always contain more organic matter than water from hills, and more albumen, or matter so conditioned that it is capable of assuming a great variety of living forms with and without locomotion. Water from the hills of Scotland and Wales, Cumberland, and many parts of North England, gives rise to no variety of living forms; and, in many of them, there is scarcely anything to be remarked in the deposit, unless opportunity is given for collecting it from a large quantity of water, and concentrating. On studying this subject many years ago, I found that, in some of those cases where the water was peaty, there was also to be found a large amount of ammonia. The words I used were these:—"In a peat bog which is not well drained, and is, therefore, wet and cold, the acids of the peat do not become dissolved so as to form a very deeply coloured solution, but they form a solution of a pale yellow. But in grounds which are warmer, or, what is better, well drained, the amount of soluble matter is very great. The colour of such water is not to be confounded with the water which heavy showers bring down, filled with mud and bits of peat; it is often perfectly clear and bright, but brown like coffee. The acids in solution at such times are kept so by the presence of ammonia. Ammonia dissolves them in large quantities, and along with them also the salts which they form with lime, magnesia, soda, phosphates, &c.

"Plants begin to grow in warm weather; at this time ammonia is formed. It is at this time the organic matter decays, and, in its approach to inorganic matter, passes through this stage of ammonia.

"The peat mould Mulder has shown, but he has not mentioned this excess of ammonia."

I supposed at the time, as it appears, that the ammonia produced by the decomposition of vegetable substances was used for the solution of the ammoniacal humates of Mulder. The paper read was only a short note intended to call attention to an important and curious point—the amount of ammonia on those bare hills. I have had the subject before me frequently since that period, namely, 1847, but have never given it all the time required for its elucidation. Lately, Professor Wanklyn and Messrs. Miles Smith and Chapman have examined the hill-waters, and have rather alarmed the public by informing them that they contain more albumenoid matter than waters coming from rich plains. The process they adopted has, no doubt, shown two conditions of the nitrogen; and it is possible that one may be albumen; but it seems perfectly clear that it is not putrescible albumen. I had long ago found the nitrogen; it still remains to find out all the conditions of its existence. If waters containing nitrogen from the hills are allowed to stand, they neither show their nitrogen by the production of living forms in proportion to the amount of that element, nor by putrefaction; any fear, therefore, of such results may be entirely put out of our minds. The living forms, which are the most dangerous, are fewer than from pretty deeply filtered water of the plains; and putrefaction cannot exist when the matter to putrefy is so minute: when the solutions are extremely weak, oxidation overpowers it. Such, at least, is my experience.

A reason for believing that nitrogen exists as albumen is the large amount of fish which the water supports. But protein exists in many conditions. The learned originator of the word had the idea of the prophetic and changeable Proteus in his view, as well as the rank of the substance as first in importance, because it forms man. I think, however, the probability is that the earth acids keep it from change, united to the generally low temperature on the hills. This latter, however, does not seem needful. These soils saturated with peaty water are not to be compared to flat, wet, and ague-bringing grass and other lands. I find the process of Professor Wanklyn still more valuable since I wrote the above, although I adhere

to the reasoning that, although he may be right in believing albumenoids to be present, the water is not, to that extent, hurtful. The same applies to the reasoning, as I understand it, of Dr. Frankland. But we need not quarrel; it is enough if we each try to elucidate the subject.

(To be continued).

ON THE PROXIMATE ANALYSIS OF COALS.*

By Prof. GUSTAVUS HINRICHS,
Chemist of the Geological Survey of Iowa.

DETERMINATION OF THE MOISTURE.

A FLAT-BOTTOMED iron pan, of 20 centimetres in diameter, was filled evenly to the depth of $1\frac{1}{2}$ centimetres with sand, and the latter was covered with a copper plate, on which the watch glass containing the coal was placed. A thermometer (scale to 370° C.) was, by means of a rubber stopper, inserted in an iron arm of the tripod supporting the iron pan, and held with its bulb about half a centimetre above the copper plate. By means of a Bunsen burner it was found very easy to keep the thermometer perfectly constant at 115° C. This apparatus I consider a good substitute for Fresenius's iron plate.

The coal to be dried was finely pulverised, direct experiments having convinced me that the application of fragments was not only very much slower, but also erroneous, on account of the peculiar property of bituminous coal treated of below.

In order to show the accuracy of this method, I transcribe the following examples from my journals:—

No. of Coal.	Weight of Portion.	Time.	Moisture.		Mean.
			Per cent.	Deviation from Mean.	
390 e	0.961	1 hour	4.888	-0.004	4.892
" f	0.919	1 "	4.896	+0.004	"
" e	0.961	2½ "	4.160	+0.010	4.150
" f	0.919	2½ "	4.140	-0.010	"
339 e	1.452	1 "	8.260	+0.070	8.190
" f	0.975	1 "	8.120	-0.070	"
" e	1.452	3 "	7.160	+0.170	"
" f	0.975	3 "	6.830	-0.160	"
338 e	1.415	1 "	3.852	-0.029	3.881
" f	0.805	1 "	3.911	+0.030	"
" e	1.415	2½ "	3.287	+0.123	3.164
" f	0.805	2½ "	3.042	-0.122	"
" e	1.415	5½ "	2.722	+0.088	2.634
" f	0.805	5½ "	2.546	-0.088	"

These results—a few taken from among a great number of determinations—show that the loss (called moisture) decreases regularly after the first hour of drying, that is to say, while the coal loses in weight during the first hour, it steadily gains in weight thereafter. It appears, furthermore, that the accuracy of a determination, expressed in the smallness of the deviations from the mean, is greatest at the end of the first hour of drying, least after about three hours of drying, and thereafter increases again, as expressed in the diminution of the deviations after 5½ hours' drying in coal No. 338.

On account of these peculiar properties of our bituminous coal, I put down as *moisture* the loss in weight of the finely-pulverised coal after one hour's drying at a temperature between 105° and 110° C.

ON THE SLOW OXIDATION OF COAL.

This increase in weight after the first hour's drying I have found in all Iowa investigated as yet. I have also found it to occur in a sample of coal (Steinkohle) from Benthien, Silesia, which showed a loss of 3.62 per cent at the close of 1 hour, and in 4 further hours' drying gained again 0.42 per cent. It was not noticed in brown coal

from Bilin, Bohemia, nor in anthracite from Pennsylvania. I am, therefore, inclined to believe this to be a property peculiar to pit-coal (steinkohle).

On page 401 of vol. 1, p. 1, of the "Iowa Geology," Professor Whitney remarks: "A remarkable fact in connection with the determination of the water present in the specimens of coal has been noticed. In numerous instances, after the sample, in the form of a coarse powder, had been dried for several hours in the air bath, at a temperature a little above that of boiling water, during which time it had gradually lost weight until all the water seemed to have been expelled, on continuing the operation for some time longer, a slight increase of weight would become perceptible, and the coal would continue to grow heavier, until a gain of several tenths of a per cent of the original weight had been made. This appears to be owing to the slow oxidation of the sulphur which all these coals contain in a finely divided state, disseminated in invisible particles through the mass, and, perhaps, partly in combination with iron."

It is evident that Professor Whitney failed to discover this property as a general one, because he had the coal in coarse fragments. The want of correspondence in the results of determinations of moisture in the same sample, dried at the same time, but of different weights, made me apply the coal in the form of powder. Thereby the turning point was reduced from "several hours" to less than one hour, the "numerous instances" extended to all samples investigated, the "slight increase of several tenths of 1 per cent" became often 2 and even 4 per cent! Instead of numerous exceptions we now discovered a general law.

We have failed, as yet, to notice any "sulphur" disseminated through the Iowa coal; what popularly is called sulphur is pyrites. Professor Whitney has given no proof of the existence of real "sulphur" in the coal. It is, therefore, unsatisfactory to ascribe this property of the bituminous coals to such "sulphur."

Pyrites might well be the cause of this phenomenon; the red ashes obtained in many cases (in Van Buren county, Iowa, invariably from the upper part of the coal bank) may well be ascribed to pyrites disseminated through the coal in invisible particles. Two FeS_2 will give $\text{Fe}_2\text{O}_3 + 4\text{SO}_3$ by exactly doubling their weight.

In order to decide the question, I select the following results from my analyses:—

INFLUENCE OF TIME OF DRYING.

Top coal ..	No. of samples,	4	3	2
	Time of drying,	2	3	4—5 hours.
	Mean gain, p.c.,	0.45	0.71	0.96
Bottom coal ..	No. of samples,	3	5	2
	Time of drying,	2	3	4 hours.
	Gain, per cent,	0.49	0.50	0.96
Mean of above.	No. of samples,	7	8	4
	Time of drying,	2	3	4—5 hours.
	Gain, per cent,	0.46	0.63	0.96
	Gain, per hour,	0.23	0.21	0.24

or, on the whole, for 19 samples of coal, very nearly proportional to the time, this being not more than four hours. It also appears that no essential difference is apparent in regard to the position of the sample in the coal bank.

By this means we may compare the following determinations, referring to two, three, or four hours drying. We find:—

Coal.	Place—No.	Time. hours.	Increase, Total.	Per ct. per hr.	Difference.	Colour of Ashes.
{ top	390	2	0.75	0.38	0.22	pale brown.
	bottom 384	2	0.35	0.16		white.
{ bottom	395	4	0.80	0.20	0.04	red and white.
{ top	375	4	0.64	0.16		white.
{ top	346	3	0.68	0.23	0.08	reddish brown.
{ bottom	371	3	0.45	0.15		white.

* Communicated by the author. For a previous paper on this subject see, also, vol. xviii., p. 53.

Coal. Place—No.	Time. hours.	Increase, Total.	Per ct. per hr.	Difference.	Colour of Ashes.
top 336	3	0.76	0.25		gray.
				0.06	
bottom 334	3	0.58	0.19		gray.
top 333	3	1.17	0.39		pink.
				0.09	
bottom 340	3	0.91	0.30		light gray.
middle 357	3	0.55	0.18		white.
				0.03	
top 370	3	0.46	0.15		reddish.

Except in the coal from the last mine, we notice that the more ferruginous ash does correspond to a slightly greater increase in weight; but we notice also that this difference is but very small as compared to the total amount of increase, being only 1-5 to 1-3 of the whole. Arranging these coals in the order of this hourly increase, we find the colour of the ashes not at all forming a regular series from white to red, as it ought to be, if this increase was mainly depending upon the oxidation of the pyrites. Besides, the mean of the four white ash coals is 0.16 per cent hourly increase, while the mean of the four coals showing the greatest increase is only 0.33 per cent, or double the former.

Coal.	Increase, per cent.	Ash.
333	0.39	pink.
390	0.38	pale brown.
340	0.30	light gray.
336	0.25	gray.
346	0.23	reddish brown.
395	0.20	red and white.
334	0.19	grey.
357	0.18	white.
375	0.16	white.
384	0.16	white.
371	0.15	white.
370	0.15	reddish.

The greater increase of the pyritiferous coals is accounted for by the oxidation of the pyrites they contain; the comparatively great increase of coals giving a pure white ash seems to force the conclusion upon us that the bitumen of the coal itself oxidises, and that to this oxidation the main increase of all these bituminous coals must be ascribed. Remembering, now, our result regarding the deportment of bituminous coal from Silesia, anthracite from Pennsylvania, brown coal from Bohemia (all of which gave ashes very nearly of same shade, and all of which had been in my air-heated laboratory for two years), it seems not unlikely that this is another characteristic chemical difference between bituminous coals and other fossil coals.

In conclusion, I will give only two additional determinations, showing a very considerable increase in weight, and also that the process of oxidation is completed in about six hours for two-thirds grammes of coal. For No. 329, containing 8.30 per cent of grey ashes, gained in $5\frac{1}{2}$ hours 2.05 per cent of its original weight. Coal No. 348, with 6 per cent red ashes, weighed 0.693.

	Change. Weight.	Per cent.	Total loss Per cent.
After $\frac{3}{4}$ hours,	0.630	loss 0.063—9.091	9.091
„ 2 „	0.625	„ 0.005—0.722	9.813
„ $5\frac{1}{2}$ „	0.656	gain 0.031—4.474	5.339
„ $8\frac{1}{2}$ „	0.656	„ 0.000	5.330

DETERMINATION OF THE ASHES.

The best way to determine the ashes in coal I found to be the coking of the finely pulverised coal in a small platinum dish (weighing about 8 grammes) with subsequent incineration of this coke in the same vessel. The incineration takes place with great ease and rapidity, and the results are perfectly satisfactory. Thus 3.022 grammes of coal No. 333 gave 2.25 per cent, and 5.263 grammes of the same coal gave 2.58 per cent, deviating from the mean 2.46 by + 0.11.

In regard to the ashes of our Iowa coals, I have found

that they are very much more uniform in their distribution throughout the coal fields than usually thought possible. In Van Buren county I find the "bottom" coal giving a white or light coloured ash, the "top" coal of the same bank a red-coloured ash, a fact which I intend to make use of in a subsequent paper on the origin of our coal. I also find the amount of ashes to increase quite evenly (in this county) toward the margin of the coal field from about 2 to 7 per 100 combustible.

DETERMINATION OF SPECIFIC GRAVITY.

Coarse fragments, freed by means of a sieve from all small particles, and averaging 1-10th cubic centimetres in volume, were introduced into a fifty-gramme flask provided with thermometer stopper. The constants for this flask for temperatures varying from 50° to 80° F. had been carefully determined.

The given specific gravity corresponds to the coal perfectly soaked, so that all its pores were filled with water. That required, on the average, 12 hours, permitting two determinations per day, one in the morning, another in the evening.

That this is not at all trifling may be seen from the following example:—2.760 grms. coal (No. 350) gave the specific gravity 1.309 at 64° F., immediately after filling the flask with water; after about 12 hours' soaking, the specific gravity had increased to 1.328, for the same temperature. According to this latter determination, a cubic foot of this coal would weigh 82.76 lbs.; according to the former, only 81.58, or 1.18 lbs. less. This shows a considerable degree of porosity of the coal, and indicates the absurdity of giving the weight in pounds of a cubic foot of coal with four decimals, although no statement in regard to temperature or time of weighing is made! Such accuracy we meet with in some of the official reports!

CALCULATION OF RESULTS.

Referring to my previous paper (CHEMICAL NEWS, vol. xviii., p. 53), it may be sufficient here to state that, besides the percentage composition of the coal, it is proper to reduce the composition to the combustible=100, in order to obtain a proper comparative estimate of the character of the fuel itself (in regard to the proportion of bitumen and carbon), and of the amount and quality of the impurities (ashes and moisture). It has also been shown in the paper referred to, that, for considerable areas of the coal field, the sum of the constituents on the scale of combustible=100 is the proper caloric equivalent, and that the percentage of the combustible in the fuel gives a proper estimate of its value.

According to this method, a considerable number of analyses of Iowa coals have already been made, and a greater number are yet to be executed. It is believed that the results will be strictly comparable for the entire coal-field of Iowa, and that the conclusions, both practical and theoretical, will deserve some confidence.

A New Alloy (says *Iron Age*), forming, we are told, a beautiful white metal, very hard and capable of taking a brilliant polish, is obtained by melting together 70 parts of copper, 20 of nickel, $5\frac{1}{2}$ of zinc, and $4\frac{1}{2}$ of cadmium; it is, therefore, a kind of German silver, in which part of the zinc is replaced by cadmium. It is used largely in Paris for the manufacture of spoons and forks, which resemble articles of silver.

Amalgamation of Zinc for Galvanic Batteries.—In a somewhat lengthy, and not by any means very lucidly written, paper in *Les Mondes*, M. D'Almeida has described a series of experiments made by him with amalgamated zinc and other metals, and, moreover, with polished substances, such as glass, to prove that the cause of the very far less rapid solution and attack of zinc and other metals when placed in contact with acids, which, unless the said metals were amalgamated, would rapidly corrode and dissolve the same, is due, after amalgamation especially, to the physical change of the surface of the metal, and, as a consequence thereof, the adhesion to the metal of a thin layer of very minute bubbles of hydrogen gas retained to that surface by capillary action, and, as a consequence of their presence, the non-immediate and direct contact of the metal with the acid it is immersed in, but action of the latter upon the former through a layer of very minute bubbles of gas, which appears to be one of the causes of the slower corrosion of amalgamated zinc. The author has made a series of experiments, too long to be described in detail, which, certainly as far as the description goes, appear to prove his theory on this subject.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

June 3rd, 1869.

Dr. W. A. MILLER, V.P.R.S., &c., in the Chair.

THE minutes of the preceding meeting having been read and confirmed, the following certificates were read:—

For the first time—John Morrison, Analytical Chemist, County Wicklow, Ireland; W. G. Lewis, Fellow of Oriel College, Oxford; Alfred Dudley Keightley, Gatcheck Gunpowder Mills, Old Hall, Milnthorpe, Westmoreland.

For the second time—Temple A. Orme, Teacher of Chemistry and Experimental Physics in University College School; W. Fletcher Barrett, Lecturer on Physical Science at the London International College.

For the third time—William G. Valentin, Assistant in the Royal College of Chemistry, 126, Lancaster Road, Notting Hill; Thomas Gilham Hewlett, Surgeon, Bombay; Captain A. Noble, Engineer, Elswick Ordnance Works, Newcastle; H. Stillington Grey Stephenson, B.A., Oxford, Sympsham Rectory, Weston-super-Mare. The last-named gentlemen were balloted for and duly elected.

Mr. Gerstl was proposed as an associate of the Society.

The PRESIDENT (Dr. Williamson) then read a lecture on "*The Atomic Theory*," but, as it is difficult for us to give a condensed report which will do justice to so important a subject, and as the author has, with his usual courtesy, kindly promised to send us an abstract, we postpone our report of this paper for a future number.

The CHAIRMAN proposed a vote of thanks to Dr. Williamson, and said that it would be better to defer the discussion until the next meeting. He would, however, remark that those who opposed the atomic theory must explain how, according to the notion of the infinite divisibility of matter, they had combination in definite proportion at all. It seemed to him utterly impossible to explain combination in definite proportion by the theory of infinite divisibility.

The PRESIDENT announced that, as the next meeting would be taken up by M. Dumas's lecture at the Royal Institution, another meeting would be held for the ordinary business of the Society; the date was not, however, announced.

The meeting then adjourned till the 17th inst., at the Royal Institution.

NOTICES OF BOOKS.

Spectrum Analysis: six lectures delivered, in 1868, before the Society of Apothecaries of London. By H. E. ROSCOE, B.A., F.R.S. Macmillan and Co., 1869.

Lessons in Elementary Chemistry; Inorganic and Organic. By H. E. ROSCOE. New Edition. Macmillan and Co., 1869.

FEW men are so competent as Professor Roscoe to discuss the various processes and results of spectrum analysis. He has worked much on the subject of light, sometimes alone, sometimes with the men who founded the mode of analysis under discussion: it will also be remembered that he was the first to introduce the subject in a practical form to the attention of scientific men in this country; and he has translated many important memoirs relating thereto into English during the last few years.

The work before us appears at a peculiarly opportune time, since the recent spectroscopic observations of the eclipse of 1868, and the brilliant results in stellar chemistry obtained yet more recently, have made this branch of science perhaps more prominent than any other,

whether we look to the novelty and magnitude of its deductions, or to the fact that it enables us to exercise, not alone a cosmic analysis, but a system of analysis embracing the universe.

Starting with Newton's discovery of the composition of white light, Professor Roscoe passes to the consideration of the properties of sunlight, and of the various coloured rays composing white light. The key-note of the whole subject was struck by Newton, in 1675, in the demonstration that "lights which differ in colour, differ also in refrangibility;" he proved, at the same time, that light which has once passed through a prism cannot be further decomposed, and that the various coloured rays constituting white light, when brought together again after decomposition, form white light. The author next considers the various conditions of different portions of the spectrum, and gives illustrations of the fact that the calorific intensity of the spectrum attains a maximum near the red end of the spectrum, while the chemical intensity culminates near the violet end of the spectrum. An account of Fraunhofer's lines concludes the first lecture.

A noticeable feature of the work is the addition of an appendix to each lecture (often exceeding in length the lecture itself), in which extracts from the more important of the memoirs quoted are given, and the most recent discoveries—too late for insertion in the text of the lectures—are described. In the appendix to the first lecture, a lengthy extract is given from Newton's "*Optics*," regarding the *modus* of the original experiment on the decomposition of light. There are, also, some remarks on the application of magnesium wire as a source of light for photographic purposes, in the course of which it is stated that "a burning magnesium wire, of the thickness of 0.297 millimetre, evolves . . . as much light as seventy-four stearine candles of which five go to the pound."

The second lecture treats of the spectrum of incandescent solids and gases, and the method of producing and examining their spectra. In speaking of the delicacy of the method of spectrum analysis, it is stated that 180,000,000th part of a grain of sodium can be readily detected; 6,000,000th of lithium, and 1,000,000th of strontium. Among the more important results produced by this branch of the subject, is the discovery that lithium, previously known to exist in but four minerals, is now found to be one of the most widely-distributed metals. An interesting account is appended to this lecture of Bunsen and Kirchhoff's mode of working with the spectroscope.

The third lecture contains an historical sketch of the rise and progress of spectrum analysis, and an account of the various new elements discovered by its means. We learn from this that, so far back as 1822, the spectra of many-coloured flames were examined by Sir J. Herschel. On page 96, elaborate analyses are given of the mineral waters in which caesium and rubidium were first discovered. The lecture concludes with an account of, perhaps, the greatest application of spectrum analysis to the purposes of the manufactures which has yet been made, viz., its application to the process of making steel by the Bessemer process. In this operation, it is of the utmost importance that the operation of blowing air through the molten metal should be stopped the instant that the proper amount of carbon has been removed from the metal. "If the blast be continued for ten seconds after the proper point has been attained, or if it be discontinued ten seconds before that point is reached, the charge becomes either so viscid that it cannot be poured from the converter into the ladle from which it has to be transferred to the moulds, or it contains so much carbon as to crumble up, like cast-iron, under the hammer." The precise moment to stop is judged of by examining the flame as it issues from the mouth of the converter, by means of a spectroscope, and the moment that the carbon lines disappear from the field of view, the blast is shut off.

In the fourth lecture, Professor Roscoe discusses the spectra of metals volatilised in the electric arc, a subject which received much attention from Angström in 1855,

he having mapped no less than 32 spectra, while Mr. Huggins has mapped 24. Thalén has recently investigated and mapped the lines of some of the rarer metals; among them, glucinum, thorinum, and zirconium. At page 156 will be found two very admirable maps of metallic lines, from the drawings of Mr. Huggins, and these are followed by extracts from the memoirs in which he describes them.

In the fifth lecture is commenced the important subject of solar and stellar chemistry, an account is given of the discovery of the coincidence of the dark solar lines with bright metallic lines, of Kirchhoff's explanation of the cause of the coincidences and the deduction therefrom of the well-known theory of the constitution of the sun. We find here two very beautiful reductions of Kirchhoff's maps of the solar spectrum, together with the map of Angström and Thalén, of the spectrum from G to H₂ drawn to the same scale. An experiment is described on page 191 in which "a constantly burning black soda flame" is produced by viewing a soda flame through a surrounding shell of soda flame; this is an admirable experiment for a large audience, provided they are not seated on gradually ascending seats, when of course many look down upon the inner soda flame without looking through the surrounding flame. The appendix to this lecture contains a detailed account of the spectroscopic observations of the solar eclipse of 1868.

The last lecture is devoted to the subject of stellar chemistry, and is accompanied by a beautifully coloured map of the spectra of various stars and nebulae, among them Sirius, and the blue and orange stars of β Cygni. The spectra of Aldebaran and α Orionis drawn to scale are given on page 235; in these stars no less than seventy lines have been observed, and Dr. Miller and Mr. Huggins have detected nine elements in Aldebaran, which, strange to say, include bismuth (not found in the sun), tellurium, antimony, and mercury. Finally, the spectra of comets and nebulae are discussed, and it is stated that Brorsen's small comet, which is now visible, has been found by Mr. Huggins to give lines dissimilar to those yielded by any substance known on earth. The final appendices contain very lengthy abstracts from the memoirs of Huggins and Miller on stellar spectra, Kirchhoff's elaborate tables of the coincidences of the bright lines in the spectra of the metals with the dark solar lines, and the work is terminated by a list of the principal memoirs on spectrum analysis, divided into three parts. (1) "Lectures or Memoirs Relating to the subject of Spectrum Analysis generally," eighteen in number; (2) Memoirs relating to the Application of Spectrum Analysis to Terrestrial Chemistry, "ninety-four in number; (3) "Memoirs relating to the Application of Spectrum Analysis to Celestial Chemistry," seventy-five in number.

The great extent of the literature of the subject well indicates the rapid growth (mainly since 1861) of the science of spectrum analysis, and we have in the work before us a condensed account of everything of importance which has been done in connection with it from the pen of a man who has himself contributed no insignificant labours in this direction. As to the book itself, it is clearly and concisely written, and is in no place unnecessarily complex. The numerous illustrations, together with the maps and coloured plates, tend greatly to simplify the more abstruse matters, and we heartily recommend the book to the general as well as to the scientific reader.

We are glad to notice the issue of a new edition of Professor Roscoe's useful "Lessons in Elementary Chemistry," a work now generally used by the junior classes in those schools (happily on the increase) in which natural science is taught. The present edition contains no less than fifty-six pages more than the edition of 1866, together with a few additional woodcuts; the index is very complete and comprehensive, and the examination questions have proved of service to science masters: we feel assured that this work will continue to occupy the position which it has gained among our school books.

Observations on some of the Fundamental Principles and Existing Defects of National Education. By NEIL ARNOTT, M.D., F.R.S., &c. Longmans, 1869.

IN about 32 duodecimo pages, Dr. Arnott very clearly sketches the outline for a good and useful system of education. The little book opens with what is very aptly called a general map or table of human knowledge, showing the natural divisions. The first embraces the three Kingdoms of Nature; the second the four orders of changes or phenomena among things, the knowledge of which is called Science. The third division is divided into two sections; (a) the two arts by which man acquires and stores knowledge; (b) industrial arts, fruits of human invention.

This is a comprehensive scheme, but it certainly appears to be the right way. The subjects just enumerated are briefly but lucidly explained and discussed in the subsequent pages of the book, which is a very valuable shilling's worth.

LABORATORY NOTES.

PHOSPHORUS HOLDER.

A FEW inches of lead tube, $\frac{1}{4}$ in. bore, is contracted to an open cone, at one end. As much phosphorus as one may choose is put into the cone of the tube; the phosphorus is made to project slightly from the cone; the upper part of the tube is filled with water, and corked. Thus is had a phosphorus "crayon" perfectly safe in the hand for luminous writings, &c.

To put in the phosphorus, as much as may be required is melted in a conical glass, or test tube, the cone of which is larger than that of the lead tube.

This is put standing in the melted phosphorus, which fills the cone and tube to its own outside level. When cold, there is a nice projecting crayon, from the form of the glass. Any phosphorus outside the lead tube may be melted off.

To renew the writing point, a test-tube, conical below, is fitted to the cone of the lead; the whole held in warm water for a minute, as much phosphorus flows out as forms a new point.

E. KERNAN.

PHOSPHURETTED HYDROGEN.

THE solution of caustic potash and phosphorus are put into anything like an evaporating basin. On the application of heat, the gas comes off, taking fire at various points of the liquid surface. The cup may be very small, even a watch glass will do.

The basin with its contents may be put aside until required to act again. Even when quite cold, odd bubbles of gas come off.

An objection to this method is that the "rings" do not show; the gas bubbles are too small, and burst before they can unite to form one large one strong enough to overcome the air currents. Could this be effected, the open basin would be a considerable improvement on the retort production of phosphuretted hydrogen.

E. KERNAN.

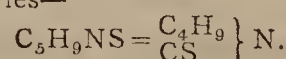
MISCELLANEOUS.

New Work by Dr. Odling.—Shortly will be published, in 1 vol., "Outlines of Chemistry; or Brief Notes of Chemical Facts," by William Odling, M.B., F.R.S., &c., Fellow of the College of Physicians, and Fullerian Professor of Chemistry at the Royal Institution. This volume will consist of the notes from which the author has lectured for the last six years at St. Bartholomew's Hospital, revised and somewhat extended, so as to furnish the student with a connected outline of the leading facts of chemistry in their relations to each other. It will be essentially descriptive in its character, and aim at calling to mind,

in as few words as possible, the ascertained origins, properties, and metamorphoses of chemical substances. It will include a systematic account of the monad, diad, and triad non-metallic elements, and their principal combinations with each other; of silicon and carbon with its series of methylic, formic, and cyanic compounds; and of the various metals, arranged, as far as practicable, in natural groups, with their respective series of halides, oxides, and oxisalts, &c.

Extraordinary Phenomenon.—The Caspian Sea or Lake is dotted with numerous islands which produce yearly a large quantity of naphtha, and it is no uncommon occurrence for fires to break out in the works, and burn for many days before they can be extinguished. Early last month, owing to some subterraneous disturbances, enormous quantities of naphtha were projected from the wells and spread over the entire surface of the water, and, becoming ignited, notwithstanding every precaution, converted the sea into the semblance of a gigantic flaming punch-bowl, many thousands of square miles in extent. The fire burnt itself out in about forty-eight hours, leaving the surface of the water strewn with the dead bodies of innumerable fishes. Herodotus mentions a tradition that the same phenomenon was once before observed by the tribes inhabiting the shores of the Caspian Sea, which exceeds in area that of England and Scotland together.

Essential Oil of Cochlearia officinalis.—It appears that this essential oil has been frequently confused with the essential oil of mustard, from which the author (Dr. A. W. Hofmann), on experiment, found it essentially different. The boiling point of the oil of *Cochlearia* is at about 160° C., that of the genuine oil of mustard at 147° C. On being treated with ammonia, the essential oil of *Cochlearia* yields a beautifully-crystallising substance (the thiosinamin of the essential oil of *Cochlearia*), which fuses at 135° C. Analyses of the oil and the ammonia compound just alluded to, prove the oil to be the mustard oil (*Senföl*), of the butyl series—



When butylamine (prepared from butyl alcohol by fermentation) is treated with sulphide of carbon and chloride of mercury, a mustard oil is obtained of the same composition and about the same boiling point, but the odour indicated that only an isomeric substance had been obtained, and further research proved that the ammonia compound of the oil, thus artificially produced, had its melting point at 90° C. The author intends to proceed with researches on this subject.—*Berichte der Deutschen Chemischen Gesellschaft zu Berlin.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we are endeavouring to effect arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.

Moniteur Scientifique, No. 299, June 1, 1869.

This periodical contains the following original papers:—

Molecular State of Bodies.—M. Persoz.—This paper is a continuation of a series already published on this subject in the above-named periodical, but far too lengthy and abstruse for abstraction.

History of Urea.—M. Bouchardat.—This is a very valuable essay, but too lengthy and too much condensed already to be fit for this portion of our paper. We may, perhaps, afterwards return to this subject.

M. Margueritte's Process of Sugar Extraction from Molasses.—The leading portion of this lengthy paper is known to our readers; it was published some time since.

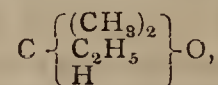
Chemisches Centralblatt, No. 19, May 12, 1869.

This periodical contains an original paper—

On the Sulpho-Acids of the Isomeric Hydrocarbons, C_9H_{12} .—M. O. Jacobsen.—Cumolsulphuric acid, $C_6H_5(C_3H_7)SO_3$. The cumol was obtained from cuminic acid, by distillation with five parts of quick-lime. (Boiling point of cumol, 149°—151° C.) It was dissolved in a mixture of equal parts of fuming and ordinary sulphuric acid, next treated with water and carbonate of baryta, and the cumol-sulphate of baryta purified by crystallisation. Free cumol-sulphuric acid is a solid substance, very soluble in water and alcohol, and is decomposed by heat without previously fusing. The author studied the potassa, ammonia, lime, strontia, baryta, zinc, copper, and other salts of this acid. The baryta salt belongs to the more stable of these substances.—Isocumol-sulphuric acid, $C_6H_5(CH_3)_3SO_3$. This acid, in a free state, is likewise a solid substance, deliquescent, and readily

soluble in water and alcohol; it fuses, but becomes at the same time decomposed. It forms crystallisable salts with bases.—Mesitylen-sulphuric acid, $C_6H_3(CH_3)_3SO_3$, is also a solid substance, crystallising in six-sided prisms, not deliquescent, readily soluble in alcohol and water, fuses at 100° C., and forms salts with bases, most of which may be obtained in regular crystalline form.—Ethyltoluol-sulphuric acid, $C_6H_4(CH_3)(C_2H_5)SO_3$. Only the baryta and potassa salt of this acid were obtained.—The sulpho-acid of phoron-cumol is a solid substance, readily soluble in water and alcohol; the baryta salt is sparingly soluble in water, and less soluble even in alcohol.

On Ethyldimethylcarbinol.—M. A. Popoff.—This substance—



is a fluid boiling between 98.5° and 102° C., and does not freeze at -17° C. Its percentage composition is—C, 68.18; H, 13.62. On being oxidised with chromic acid, it yields acetic acid only.

Bayerisches Industrie und Gewerbeblatt, No. 2, 1869.

This periodical contains chiefly original papers and communications relating to machinery and mechanical engineering; the only original chemical paper is—

Colouring Matter of Wafers.—Dr. Furtenbach.—Although wafers are at the present day far less commonly used for sealing letters than was the case before the introduction of the machine-made gummed envelopes, the researches on this subject are not without interest. The manufacture of wafers is largely carried on at Nuremberg and Munich, and other towns of Germany, and the samples submitted to research were made in the two places just named. Small bright-red coloured wafers left, on incineration, an ash, consisting of oxide of lead, sulphate of baryta, and some sulphate of lead; another sample of wafers, of very bright red colour, was found to be free from sulphate of baryta, and the lead, having been quantitatively estimated, was found to amount to 46.9 per cent of red lead. White wafers were coloured with sulphate of baryta—no white-lead was found; blue wafers are coloured, partly with ultramarine, and partly with Prussian blue, but contained, in all instances, besides these substances, sulphate of baryta, and, in some cases, some white-lead; pink-coloured wafers contain carmine lake, alumina being found in the ash; brown coloured wafers are tinged with iron ochre; violet wafers were found to be coloured with some violet lac-dye, containing alumina; black wafers are coloured partly with lamp-black, and also with harmalin-black, which, on incineration, left oxide of iron; green coloured wafers are coloured with so-called green cinnabar (chromate of lead and Berlin blue, mixed), also with poisonous copper and arsenical compounds; buff-coloured wafers are coloured with a mixture of oxide of lead, sulphate of baryta, and some oxide of iron.

Journal de Pharmacie et de Chimie, No. 5, May, 1869.

This paper contains the following original essays and papers:—

Formation and Decomposition of Disulphide of Carbon.—M. Berthelot.—Too long and too abstruse for abstraction.

Action of Ammonia upon Phosphorus.—M. Commaille.—The contents of this paper have been already given in an abridged form.

Influence of Pressure upon Chemical Phenomena.—M. Cailletet.—Too long for condensation.

Mineral Chalybeate Water from the Département de Maine et Loire.—M. Andouard.—Of local interest only.

The remainder of this number of this periodical is filled with abstracts from the *Comptes Rendus* and other papers already noticed by us.

Journal für Praktische Chemie, No. 5, 1869.

This periodical contains, in the first place, three papers, by the late Professor Schönbein, on the following subjects:—

1. Peroxide of Hydrogen as a Medium for Recognising the Ferment-like Properties of Organic Matter.

2. Peculiar Activity of One-Half of the Oxygen Contained in Oxide of Copper, and the Dependence thereupon of a Highly-Delicate Reagent for Hydrocyanic Acid and Cyanides.

3. Existence of Peroxide of Hydrogen in the Atmosphere.

We regret that the above essays, though highly interesting, are too long for abstraction; perhaps we may, at a future day, give abbreviated translations of some of them.

On Hydrocarbons.—M. Fritzsche.

On Benzol.—M. Rochleder.

On Catechin and Catechutannin.—M. Rochleder.

Behaviour of Narcein towards Iodine.—M. Stein.—The author has found that narcein is coloured blue by iodine, but only when the alkaloid is in a solid state; for as soon as the crystals of narcein become dissolved, the colouration disappears. None of the other alkaloids of opium behave in the same manner with iodine.

Analysis of an Alloy found at Pompeii.—M. Milan Nevole.—Specific gravity of alloy, at 13° C., 6.66. It contained, in 100 parts:—

Silica, 0.08; lead, 1.12; copper, 55.04; iron, 29.56; antimony, 3.53; zinc, 10.67.

Decomposition of Disulphide of Carbon by Heat.—M. W. Stein.—The author states that the vapour of perfectly pure disulphide of carbon, prepared on purpose for this experiment, was not decomposed when passed through a porcelain tube kept red-hot by a Bunsen gas burner; but, on repeating the experiment, and increasing the heat, by the application of a strong coke and charcoal fire, the inner space of the tube having been filled with broken porcelain, it was found to be lined with a deposit of carbon, owing to the decomposition of the sulphide, while sulphur was collected in a receiver.

Isocitric Acid.—M. Rochleder.—This acid is formed when citric acid in aqueous solution is treated with sodium amalgam, care being taken to keep up an acid reaction of the liquid by the addition of dilute sulphuric acid. The isocitric acid may be obtained pure by a rather circuitous process, and then exhibits a crystalline mass, which has not yet been further investigated; neither have any of the salts it forms been studied.

Polytechnisches Journal von Dingler, second April number, 1869.

This periodical, though chiefly bearing upon mechanical science, occasionally contains original communications which are interesting to our readers; from the present number we only abstract:—

Very Durable Cement for Iron and Stone.—M. Pollack, of Bautzen, Saxony, states that, for a period of several years, he has used, as a cement to fasten stone to stone and iron to iron, a paste made of pure oxide of lead, litharge, and glycerine in concentrated state. This mixture hardens rapidly, is insoluble in acids (unless quite concentrated), and is not affected by heat. M. Pollack has used it to fasten the different portions of a fly-wheel with great success; while, when placed between stones, and once hardened, it is easier to break the stone than the joint.

First May number, 1869.

The greater number of the papers of the present number relate to mechanical science; we notice briefly:—

Diaphanometer to Determine the Transparency of Different Kinds of Glass.—M. Jicinsky.—Without the engravings, it is impossible to make this instrument understood, but, from what is said about it, it is no doubt a useful instrument, especially as the author has proved that the diaphanicity of divers kinds of glass is not dependent so much on its chemical composition, as on certain physical properties due to the heat applied in making it.

Improvement of Acid Waters often Pumped up from Coal-Pits and Mines.—Dr. Willigk.—The author had an opportunity to analyse a water pumped up from a coal-pit in Bohemia. This water, it appears, was very acid, from acid sulphates and some free sulphuric acid present therein, consequently attacking and corroding the pumping gear and machinery, and seriously affecting the steam boiler wherein it had to be used. No other feed-water being on the spot, the author advised, and with good success, that the water should, previous to use, be filtered over witherite, carbonate of baryta, which happened to be abundantly present in that locality.

Analysis of a Cement Marl.—Dr. Lindenmeyer.—In 100 parts:—Lime, 36.84; carbonic acid, 28.50; silica, 23.24; alumina, 4.30; peroxide of iron, 1.14; magnesia, 0.96; potassa, 1.48; water, 2.45. Of this quantity, 29.16 per cent was insoluble in hydrochloric acid.

Volumetrical Estimation of Sulphuric Acid.—Dr. A. Clemm.—After reviewing the methods of R. Wildenstein and Carl Mohr, applied for this purpose, the author describes his mode of operating at length. Briefly stated, his method is the following:—The solution to be experimented upon is coloured with litmus, and very carefully neutralised; a solution of chloride of barium of known strength is added in excess, and all the sulphuric acid thereby precipitated. Next, a titrated solution of carbonate of soda is added, in order to precipitate the excess of baryta; and next, again, the excess of soda solution used is estimated, volumetrically, by means of a titrated dilute sulphuric acid. During these operations, no salt is formed which can injure the colour of the litmus. In case salts might be present in the original solution, the bases of which could be precipitated by carbonate of soda, that precipitation is performed previous to the addition of soda. The filtrate, which contains the sulphuric acid combined with soda, is neutralised, and again volumetrically titrated. The solutions required for this experiment are:—A solution of chloride of barium, containing 52 grms. to the litre of water; a solution of carbonate of soda, containing 26.5 grms. of this salt to the litre of water; a solution of sulphuric acid, containing 20 grms. of strong sulphuric acid to the litre of water. These solutions agree among each other, drop for drop. The advantage claimed for this method is the non-necessity of having to wash out the sulphate and carbonate of baryta, and also the advantage that titration does not take place in a fluid rendered turbid by therein-suspended sulphate of baryta, which always tends to render the observation of colouration of litmus more difficult.

Experiments on the Direct Decomposition of Sulphide of Calcium as met with in Soda Waste by means of Chloride of Manganese.—Dr. Richter.—The author has instituted experiments with the view to obtain, directly, the sulphur in such a state as to render its extraction, by means of sulphide of carbon, an easy matter. Although he has not succeeded quite so well as he desired, he says he hopes his experiments will be repeated by others on a larger scale.

Cryolite Glass, or so-called Hot-Cast Porcelain.—M. Benrath.—The specific gravity of a sample obtained by the author, director of

the Imperial Russian Plate-Glass Works at Dorpat, from the American Hot-Cast Porcelain Company, was found to be 2.471. Composition, in 100 parts:—Silica, 67.07; alumina, 10.99; peroxide of iron, 1.02; protoxide of manganese, 1.09; lime, traces; soda, 19.38.

Annalen der Physik und Chemie, von J. C. Poggendorff, No. 3, May 15, 1869.

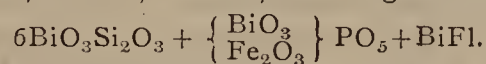
This periodical contains the following original essays, chiefly relating to mathematico-physical subjects, and hence too abstruse for abstraction:—

Construction of Galvanometers to be Applied when Electric Discharges take place, and on the Way Followed by Electric Co-Currents (Nebenströme).—M. E. Edlund.

Compounds of Tantalum and Niobium.—M. Rammelsberg.—This is the concluding portion of a lengthy essay on this subject.

Reproduction of Siemens's Unit of Resistance.—M. von Dehms.

Mineralogical Miscellany.—M. von Rath.—*Angles of the Vivianite System.*—*Chemical Formula of Silicate of Bismuth.* Eulytin contains, in 100 parts:—Oxide of bismuth, 69.38; silica, 22.23; phosphoric acid, 3.31; peroxide of iron, 2.40; oxide of manganese, 0.30; hydrofluoric acid and water, 1.01; total, 98.63. The specific gravity of this mineral, at 17° C., is 6.106; formula, according to this author—



Crystalline Form of Atelestite.—*Labradorite from Närödal, near Gudvangen.*—*Boulangerite from the Argentiferous Sand near Mayen.* This mineral is made up according to the formula $3\text{PbS}, \text{Sb}_2\text{S}_3$, and contains, in 100 parts:—Sulphur, 18.21; antimony, 22.83; lead, 58.96. —*New Crystalline Alloy of Zinc and Calcium.* This alloy contains, in 100 parts:—Zinc, 95.13; calcium, 4.87. Formula, Zn_{12}Ca ; crystalline form, quadratoctahedron; specific gravity, 6.3726; when in contact with water, hydrogen is at once disengaged by this alloy.

Collections of Meteorites.—M. Buchner.

New Sulpho-Salts.—M. R. Schneider.—Sulphide of potassium and iron, $\text{K}_2\text{Fe}_2\text{S}_4$, in 100 parts:—Potassium, 24.59; iron, 35.19; sulphur, 40.22. Sulphide of potassium and bismuth, $\text{K}_2\text{Bi}_2\text{S}_4$, in 100 parts:—Potassium, 12.57; bismuth, 66.85; sulphur, 20.58.

Galvanic Relations of Palladium.—M. Poggendorff.

Simple Expression for the General Fundamental Principles of Electric Action.—M. Weber.—A mathematical essay.

Galvanic Resistance of Liquids.—M. Paalzow.

Minerals met with in the Baryta-Bearing Gangue of Wittich, in the Duchy of Baden.—M. Petersen.—Analysis of *Wittichenite*. Specific gravity, 4.45. It contains, in 100 parts:—Sulphur, 20.30; arsenic, 0.79; antimony, 0.41; bismuth, 41.13; iron, 0.35; copper, 36.76; silver, 0.15; zinc, 0.13. —*Epigenite*. In 100 parts:—Sulphur, 31.57; arsenic, 12.09; bismuth, 2.12; iron, 13.43; copper, 40.32; traces only of silver and zinc. —*Magnetic Pyrites*, in hornblende. In 100 parts:—Sulphur, 39.93; arsenic, 0.15; lead, 0.10; copper, 0.36; iron, 58.31; nickel and cobalt, 0.63; with traces of titanium, manganese, bismuth, and minute traces of silver.

Specific Gravity of Basaltic Lava.—Dr. A. von Lasaulx.—It appears that this material varies in specific gravity from 1.93 to 2.79. Eight different samples were operated upon, all of which had been previously reduced to a finely-divided powder.

Pharmaceutische Zeitschrift für Russland, March and April, 1869.

We take these two numbers together, since the leading original paper contained therein is carried through both these numbers. The paper is an essay, bearing the title—

Glycerine: its History, Manufacture, Occurrence, Estimation of Purity, and Various Applications.—J. W. Klever.—Glycerine is met with in some natural oils and fats, also in the products of the vinous fermentation of sugar; hence it is found in wine in small quantity. It does not occur in fats as such by itself; these substances are to be considered rather as ethers. 100 parts of glycerine dissolve of:—Arsenious acid, 20 parts; benzoic acid, 20 parts; oxalic acid, 15 parts; bichloride of mercury, 27 parts; corrosive sublimate, 7.50 parts; alum, 40 parts; arseniate of potassa, 50 parts; sulphur, 0.10 parts; strychnia, 0.25 parts; morphia, 0.45 parts; acetate of morphia, 20.0 parts. The following substances are insoluble in glycerine:—Ether, benzol, camphor, sulphide of carbon, chloroform, the bromide and iodide of mercury, calomel, fatty acids, fatty and ethereal oils. Glycerine is decomposed by chromic acid, bichromate of potassa, and permanganate of potassa.

On the Microscope, and the Discoveries made by it.—M. O. Löwenthal.—This paper contains a short history of the discoveries made by this useful optical instrument, from Antony van Leeuwenhoek's time down to the present age.

Testing Chloroform for the Presence of Alcohol and Ether.—The chloroform should be first treated with fused chloride of calcium, to eliminate any water, next some iodine should be added. If the chloroform is free from either alcohol or ether, the colour produced by the solution of the iodine is bright red; but when either alcohol or ether are present, the colour of the solution is brown. In order to distinguish between alcohol and ether, a small piece of a crystal of fuchsin is added to the chloroform in question; when the slightest trace of

alcohol is present, a deep red solution will ensue. Perfectly pure chloroform yields, with fuchsin, a solution which is only slightly pinkish tinged.

Salt Deposit near Berlin.—M. Jahn.—It appears that there has been discovered near Berlin, at Sperenberg, a rock-salt deposit, which in some localities has a thickness of 669 feet. The locality where this important discovery has been made is within eight miles from the capital city of Prussia, and, from borings instituted, it appears, in every aspect, a highly valuable mineral deposit.

Non-Identity of Caffeine and Theine.—M. Hager observes that, although elementary chemical analysis of these substances yields results which would conclusively prove the identity of these two substances, yet the author found that the physiological effect, after partaking of a dose of 0.25 grm. of both substances, in chemically pure state, and prepared by himself, is by no means the same. The human organism is imbued with testing powers, compared with which chemical reagents are of little delicacy.

On the Ground Nut, *Arachis Hypogæa*.—M. F. A. Flückiger.—This is a monograph on the subject, and includes the origin, discovery, occurrence, and commercial history of the fruit of a plant belonging to the natural order of the *Leguminosæ*. The fruit is known, in English language, as ground-nut, earth-nut, pea-nut, and manilla-nut; in French as *arachide*, or *pistache de terre*. The plant which yields this fruit is a native of tropical and sub-tropical regions, and belongs especially to Africa. The average weight of the seeds contained in the fruit and bearers of the oil is 0.5 grm.; they yield from 38 to 50 per cent of oil, which consists of a mixture of glycerine compounds and three different fatty acids—arachinic acid, $C_{40}H_{80}O_4$, fusing at $75^\circ C$.; hypogæic acid, $C_{32}H_{64}O_4$, fusing at $35^\circ C$.; and palmitic acid, $C_{32}H_{64}O_4$, fusing at $62^\circ C$. The seeds contain 28.85 per cent of protein compounds, 13.87 per cent of woody fibre, and 7.16 per cent of gum and sugar.

Sensitiveness of Divers Methods for the Detection of Arsenic.—M. Frank.—Marsh's apparatus admits of detecting 0.0003 milligramme AsO_3 , dissolved in 150,000,000 of its weight of liquid; the method of Von Babo and Fresenius admits of detecting 0.002 milligramme AsO_3 ; Reinsch's method, by means of copper, detects 0.001 milligramme AsO_3 , in 5,000,000 as much liquid; Rieckher's method, by means of ammoniacal nitrate of silver solution, detects 0.002 milligramme in 3,000,000 parts of liquid.

NOTES AND QUERIES.

Rendering Walls Impervious to Damp.—I am at present erecting a new laboratory, and am anxious to get the walls, &c., as impervious as possible to damp. Can any of the readers of the *CHEMICAL NEWS* tell me what agent is the best to use for this purpose on brick, plaster, and cement? A wash of silicate of soda has been recommended, but I fear the effects of efflorescence afterwards. Would a mixture of silicate of soda with some other agent obviate this? I see several makers of soluble glass advertise in your columns, perhaps they might be induced to answer this question.—BUILDER.

Recovered Grease.—Could any of your readers tell me how to detect recovered grease in tallow.—C. W.

Picrates.—Can any of your correspondents tell me the simplest and cheapest way of making picrate of ammonia and other picrates.—T. E. D.

Scale of Temperatures.—Will any of your numerous correspondents kindly direct me to any good and dependable scale of temperatures at which glasses and metals fuse, comprising all usual silicates of potassa and soda, and such compound metals as have been noted, the object being to obtain a pyrometric gauge for temperatures between 900° and $2000^\circ F$.—ALFRED PAYNE.

Colour of Vermillion.—It is a fact well known to artists, that the splendidly bright colour of vermillion (cinnabar, sulphide of mercury) has a tendency, especially if it has been mixed with white-lead, to become blackish brown and very dark coloured in a comparatively short time. This tendency of the vermillion is altogether obviated if, previous to being mixed with oil, it is thoroughly and intimately mingled with about $\frac{1}{4}$ th of its weight of flowers of sulphur.

Action of Different Bodies on Sulphuretted Hydrogen.—M. Böttger remarks that oxide of thallium inflames this gas when coming into contact with it; so do pure peroxide of manganese, peroxide of lead, and peroxide of silver obtained galvanically. With binocide of barium, chlorate of lead, and chlorate of silver, the gas becomes vigorously inflamed; fulminate of silver also inflames the gas, and the salt explodes. Iodide of nitrogen explodes in contact with this gas, which, under certain conditions, is inflamed by gun-cotton.

MEETINGS FOR THE WEEK.

WEDNESDAY, 16th.—Meteorological, 7. Anniversary Meeting.

THURSDAY, 17th.—Royal, 8.30.

Chemical, 8. Inaugural Faraday Lecture by Professor Dumas, in the Theatre of the Royal Institution.

FRIDAY, 18th.—Chemical Society Dinner at Willis's Rooms, at 6.30.

TO CORRESPONDENTS.

* * We shall feel indebted to correspondents who will forward us Reports of Local Meetings of Societies, Chemical Appointments, and any other subjects interesting to the chemical world. We regret that, owing to the increasing popularity and circulation of the *CHEMICAL NEWS*, and consequent pressure on our space, we are often obliged to delay the publication of long papers. To those correspondents who wish to favour our readers with Notes of New Discoveries, Descriptions of Apparatus, or Answers to Questions, we would especially recommend our Notes and Queries columns.

Professor Attfield's letter shall appear next week.

E. K.—The book is excellent; the price a guinea. Thanks for the notes.

Sulphate of Manganese.—(No. 494, p. 252). A letter is waiting for our querist on this subject.

E. H.—Good medicinal carbolic acid will answer the purpose; add it to the water in which the linen is washed, in the proportion of a teaspoonful of the acid to half a gallon of water.

Messrs. Macniven and Cameron, 23, Blair Street, Edinburgh.—We have received the pens, and like them much. The "Waverley" is as pleasant to use as a quill, while the "Owl" answers well for small, fine writing. The "Pickwick" is also good.

B. B.—We did not speak of the original articles contained in the periodical quoted by you, but only to articles abstracted and translated from other periodicals. We find, on page 308, a paper originally published in June last; several other abstracts are from papers as old as those published in October last year. We will assume your correction of 1868 for 1858 to be correct; but it must be remembered that we do not, unless in special cases, abstract or mention the abstracts from other foreign sources met with in the periodicals we quote. At page 323 is a paper published a year ago at the time the periodical you allude to was issued.

Communications have been received from E. H. von Baumhauer; Macniven and Cameron; Sir William Thompson, F.R.S.; T. Bloxam; E. Kernan; Johnson and Sons; E. Hayes; C. Collins; C. Tomlinson, F.R.S.; C. Williams; A. Payne; R. W. Roberts; H. Fletcher; J. Wallace; E. C. C. Stanford (with enclosure); Mawson and Swan; E. Weston; D. Swan, jun. (with enclosure); H. H. Watson; E. Jones; Dr. R. Angus Smith, F.R.S.; Young and Co.; J. Davis; J. J. Lundy; J. Gregory; J. Riley; W. A. Todd; J. Muspratt and Sons; Kingsbury and Co.; R. D. Grindley; A. Gow (with enclosure); H. Nicol; W. Smith; Evans, Lescher, and Evans; G. G. Walmsley; C. S. Romain; and G. W. Bucklyn.

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THE CHEMICAL NEWS.

VOL. XIX. No. 498.

RESEARCHES ON GASEOUS SPECTRA

IN RELATION TO THE PHYSICAL CONSTITUTION OF THE
SUN, STARS, AND NEBULÆ.*

By E. FRANKLAND, F.R.S., and J. N. LOCKYER.

I. THE Fraunhofer line in the solar spectrum, named *h* by Angström, which is due to the absorption of hydrogen, is not visible in the tubes we employ with low battery and Leyden-jar power; it may be looked upon, therefore, as an indication of relatively high temperature. As the line in question has been reversed by one of us in the spectrum of the chromosphere, it follows that the chromosphere, when cool enough to absorb, is still of a relatively high temperature.

II. Under certain conditions of temperature and pressure, the spectrum of hydrogen is reduced in our instrument to one line in the green, corresponding to *F* in the solar spectrum.

III. The spectrum of nitrogen is similarly reducible to one bright line in the green, with traces of other more refrangible faint lines.

IV. From a mixture of the two gases we have obtained a combination of the spectra in question, the relative brilliancy of the two bright green lines varying with the amount of each gas present in the mixture.

V. By removing the experimental tube a little further away from the split of the spectroscopic, the combined spectrum was reduced to the two bright lines.

VI. By reducing the temperature, all spectroscopic evidence of the nitrogen vanished; and, by increasing it, many new nitrogen lines make their appearance, the hydrogen line always remaining visible.

The bearing of these latter observations on those made on the nebulæ by Mr. Huggins, Father Secchi, and Lord Rosse is at once obvious. The visibility of a single line of nitrogen has been taken by Mr. Huggins to indicate possibly, first, "a form of matter more elementary than nitrogen," and which our analysis has not yet enabled us to detect; and then, secondly, "a power of extinction existing in cosmical space."†

Our experiments on the gases themselves show not only that such assumptions are unnecessary, but that spectrum analysis here presents us with a means of largely increasing our knowledge of the physical constitution of these heavenly bodies.

Already we can gather that the temperature of the nebulæ is lower than that of our sun, and that their tenuity is excessive; it is also a question whether the continuous spectrum observed in some cases may not be due to gaseous condensation.

ON THE ELECTROLYSIS OF NITRATES.

By THOMAS BLOXAM,
Lecturer on Chemistry, Cheltenham College.

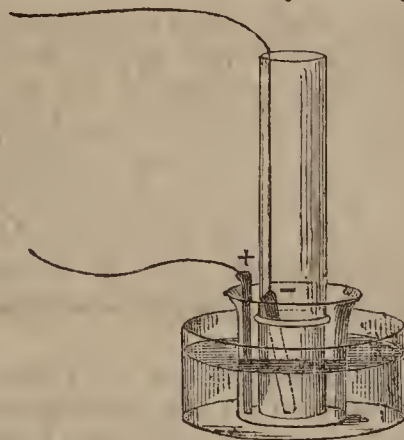
THE conversion of nitric acid into ammonia by the well-known method of boiling with zinc, iron, and potash, practised by Mr. Harcourt, suggested the idea of such conversion being possible with the hydrogen furnished by means of electrolysis. An experiment of the following nature proved the possibility in a qualitative sense:—Into a small porous earthen cylinder, 1 inch in diameter and

1½ inches high, was placed a little dilute nitric acid the negative pole of a three-cell arrangement of Bunsen's battery was introduced, and the vessel placed in a small beaker, containing dilute nitric acid and the positive pole of the battery.

The liquid was withdrawn from the cylinder in about half-an-hour, and the usual test of boiling with excess of potash was tried, when the ammonia was easily detected by the odour and its action upon test-paper.

Nitrate of potassium was substituted for the dilute nitric acid in the porous vessel: ammonia was easily detected in this case also. Nitrate of potassium solution was acidulated with hydrochloric acid, and submitted to voltaic action for an hour. The solution was mixed with bichloride of platinum, and evaporated to dryness, when a fair amount of the double chloride of platinum and ammonium was obtained. This precipitate was examined, and found to be entirely pure.

The question then suggested was, whether any quantitative result could be obtained. For this purpose, the porous cylinder used in the previous experiments was cemented to a glass tube, of the same diameter and 6 inches long, in order that any splashing caused by the escaping bubbles of gas should not cause an error. The compound tube was placed in a beaker, high enough to take the porous vessel, and just large enough to admit the positive



pole. The tube and beaker were placed in a moderately large vessel of cold water, to keep down the temperature, which, in a previous experiment, had softened the cementing material joining the tube and porous vessel. The arrangement is represented in the figure. A weighed amount of pure nitrate of sodium was placed in the porous vessel, and submitted to electrolysis,

the ammonia being estimated as the double chloride of platinum and ammonium.

From a considerable series of experiments, the amount of double chloride yielded was found to be below the calculated result. Several modifications were then tried; such as dropping the solution of the nitrate very slowly upon the negative pole, elevation of the temperature both of the solution and of the battery; reduction of the resistance offered to the voltaic battery. It is to be regretted, however, that, in spite of a fairly extensive series of experiments with these various modifications, I have only succeeded in converting half the nitrate into ammonia. It has been also proved that no loss of liquid takes place through the porous vessel.

I have been induced to make known these results with the hope of obtaining some suggestion which may solve the difficulty of the non-conversion of the other half of the nitrate.

ON THE ACTION OF HYDROCHLORIC ACID ON MORPHIA.*

By AUGUSTUS MATTHIESSEN, F.R.S.,
Lecturer on Chemistry in St. Bartholomew's Hospital,
and C. R. A. WRIGHT, B.Sc.

WHEN morphia is sealed up with a large excess of hydrochloric acid, and heated to 140°—150° for two or three hours, on opening the tubes after cooling no gas is found to have been formed, nor is there any formation of chloride of methyl. The residue in the tube contains the hydrochlorate of a new base, differing considerably in its properties from morphia. It may be obtained in a state of purity by dissolving the contents of the tube in water,

* Abstract of a paper read before the Royal Society, June 10th, 1869.

† *Phil. Trans.*, 1864, p. 444.

‡ *Ibid.*, 1868, p. 544.

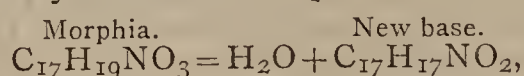
* Abstract of a paper read before the Royal Society, June 10th, 1869.

adding excess of bicarbonate of sodium, and extracting the precipitate with ether or chloroform, in both of which the new base is readily soluble, whilst morphia is almost insoluble in both menstrua. On shaking up the ethereal or chloroform solution with a very small quantity of strong hydrochloric acid, the sides of the vessel become covered with crystals of the hydrochlorate of the new base. These may be drained from the mother liquors, washed with a little cold water, in which the salt is sparingly soluble, and re-crystallised from hot water and dried on bibulous paper or over sulphuric acid.

This hydrochlorate contains no water of crystallisation. After drying in the water-bath, it yielded results on combustion with chromate of lead and oxygen agreeing with the formula $C_{17}H_{17}NO_2HCl$.

From a solution of the hydrochlorate in water, bicarbonate of sodium precipitates a snow-white non-crystalline mass, which speedily turns green on the surface by exposure to air, and is therefore difficult to obtain dry in a state of purity. This precipitate is the base itself.

It hence appears that the new base is simply formed from morphia by the abstraction of the elements of water.



We propose to call the new base apomorphia, for reasons given subsequently.

When the hydrochlorate of apomorphia in a moist state is exposed to the air for some time, or if the dry salt is heated, it turns green, probably from oxidation, as the change of colour is accompanied by an increase of weight. The base itself, newly precipitated, is white, but it speedily turns green on exposure to air. The green mass is partly soluble in water, communicating to it a fine emerald colour—in alcohol yielding also a green tint, in ether giving a magnificent rose-purple, and in chloroform with a fine violet tint.

The physiological effects of apomorphia are very different from those of morphia; a very small dose produces speedy vomiting and considerable depression, but this soon passes off, leaving no after ill effects,—facts of which we have repeatedly had disagreeable proof while working with it.

Dr. Gee is now studying these effects, and has found that 1-10th of a grain of the hydrochlorate subcutaneously injected, or $\frac{1}{4}$ grain taken by the mouth, produces vomiting in from four to ten minutes. Our friend Mr. Prus allowed himself to be injected with 1-10th grain, which produced vomiting in less than ten minutes. From Dr. Gee's experiments on himself and others, he concludes that the hydrochlorate is a non-irritant emetic and powerful anti-stimulant. As from these properties it appears probable that it may come into use in medicine, we have called it apomorphia, rather than morphinine, to avoid any possible mistakes in writing prescriptions.

CONTRIBUTIONS TO ANALYTICAL CHEMISTRY.*

By DR. E. FLEISCHER, of Dresden.

ESTIMATION OF BARYTA, STRONTIA, AND LIME.

THE estimation of these three alkaline earths is generally effected after they are separated from each other. These separations can be dispensed with if the indirect method be employed, thereby avoiding the loss attendant upon different separations, and materially hastening and simplifying the whole estimation. The following indirect method, which has proved to be the most preferable for the estimation of these three bases, may also be employed in the presence of magnesia. In the first place, the lime, strontia, and baryta, must be precipitated as carbonates, by means of carbonate of, and caustic, ammonia. The

following is worthy of remark:—It is well known that, in a liquid containing much sal-ammoniac or nitrate of ammonia, neither lime, strontia, nor baryta will be completely precipitated by carbonate of ammonia; so that, after filtering, it is possible, by means of sulphuric acid or oxalate of ammonia, to recognise a more or less considerable quantity. The cause of this phenomenon is, that ammoniacal salts of strong acids have a solvent action upon carbonate of lime, which effect is still stronger upon carbonates of strontia and baryta. Should, on the other hand, acetate or carbonate of ammonia be used, instead of sal-ammoniac or nitrate of ammonia in solution, the precipitation of the three bases by carbonate of ammonia will be so complete that it will be impossible to discover in the filtrate, by means of the before-mentioned reagents, any traces of lime, strontia, or baryta.

In order to have in solution no other ammoniacal salts than acetate and carbonate of ammonia, it will suffice to add to the tolerably neutral solution as much acetate of soda as there is supposed to be sal-ammoniac or nitrate of ammonia held in solution, and then to supersaturate with ammonia and carbonate of ammonia, and, after a short digestion, to cool the solution: the carbonated alkaline earths which have in this manner been completely precipitated are now filtered off.

Digestion is not absolutely necessary here; it only serves to render deposits granular, which would otherwise be voluminous. On the other hand, in order to obtain complete precipitation, it will be necessary to reduce the whole to the ordinary temperature before filtering, because hot acetate of ammonia has a solvent action upon carbonated alkaline earths, although in a far less degree than sal-ammoniac.

A certain degree of dilution of the ammoniacal salt is to be recommended; in any case, the solution must not be more concentrated than in the proportion of one salt to twenty water. According to rule, I manage so as to dilute the digested mass with its own volume of distilled water, allowing it to cool still further before filtration.

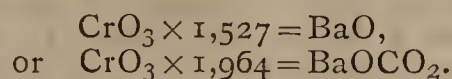
The carbonate of soda may be substituted for the acetate, in order to decompose the sal-ammoniac; but if, at the same time, magnesia be held in solution, the presence of much salts of ammonia, with stronger acids than carbonates, will be necessary, in order that it may not be deposited with the alkaline earths. For this purpose, the addition of acetate of soda is eminently suitable; because the acetate of ammonia thus formed (as with oxygenated salts of ammonia generally) prevents the precipitation of the magnesia much more than sal-ammoniac does, without, as before remarked, dissolving baryta, strontia, or lime.

In the presence of magnesia, a too great excess of carbonate of ammonia must be avoided as a reagent, in order to hinder the formation of ammoniacal carbonate of magnesia, which is difficult to dissolve. After these precautionary measures, the baryta, strontia, and lime having been separated (also from magnesia, if such be present), the deposit is washed, filtered, dried, heated, and weighed; it is then dissolved in a measured quantity of normal muriatic acid and estimated. This is done, after removing the carbonic acid by digestion, from the diluted solution (which is coloured with litmus), by estimating with one-half normal ammonia the amount of muriatic acid which had been required to transform the three carbonated salts into chlorides. The solution is now mixed with bichromate of potash and caustic ammonia in excess, to precipitate all baryta, so that no trace of it may be detected in the acidulated filtrate, by fluo-silicate of potash and spirit of wine.* The chromate of baryta is filtered off, and washed until sugar of lead ceases to give a yellow precipitate in the solution which runs through; to this chromic acid is now added, according to the known pro-

* Pure chloride of barium solution, also, produces no turbidity when, after the precipitation of baryta by chromate of potash and ammonia, the filtrate is mixed with sulphuric acid. It is, of course, understood that the reagents employed in precipitation are quite free from sulphuric acid.

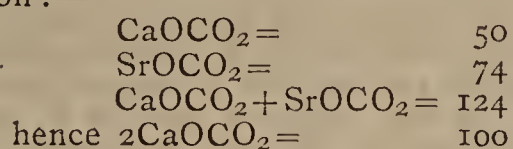
* Communicated by the Author.

cess, together with a measured quantity of a standard solution of green vitriol; and the amount of baryta is then obtained, according to the formula—



If, on the one hand, the amount of carbonate of baryta thus obtained be deducted from the weight of the three carbonates, and, on the other, the amount of muriatic acid answering to the baryta be calculated, the difference between this amount of HCl and the amount found will be the quantity of muriatic acid which corresponds to the united weight of CaO, CO_2 and SrO, CO_2 , which has just been calculated. The amount of carbonate of lime and carbonate of strontia is obtained as follows:—

Calculate the amount of carbonate of lime which is equivalent to the known quantity of HCl contained in the excess of CaOCO_2 , and SrOCO_2 ; deduct this from the weight of the two carbonated salts, and multiply the remainder by the constant factor $3,1\frac{1}{2}$ and the product will then be the required quantity of SrOCO_2 ; this, when again subtracted from the united weight of both salts, yields, as its remainder, the quantity of carbonate of lime. The constant factor, $3,1\frac{1}{2}$, may be obtained by the following calculation:—



and the remainder, 24, in the equivalent of SrOCO_2 , equal to 74, yields, when divided, $S = \frac{24}{74} = 3,1\frac{1}{2}$.

This method of estimating these three alkaline earths always yielded very satisfactory results. One advantage is that it is quickly carried out and also very exact, because the precipitations will be all perfect, and the two volumetric estimations involved in the method admit of great exactitude. Moreover, the troublesome and somewhat uncertain separation of the strontia and lime with a concentrated solution of sulphate of ammonia is avoided, and which is very inconvenient in estimating the lime. In the absence of strontia, I either precipitate the lime and baryta as carbonates,* estimating the precipitate alkalimetrically; or I precipitate the baryta as sulphate, the lime as carbonate, by digesting the solutions of both with a mixture of three parts of sulphate of potash and one part of carbonate of potash; weigh the dried and ignited precipitate, and estimate the carbonate of lime alkalimetrically.

A CHEMIST'S VIEW OF THE SEWAGE QUESTION.†

By EDWARD C. C. STANFORD, F.C.S.

(Continued from p. 270.)

No. II.

ABOUT twelve months ago, I read a paper on this subject before the Sewage Association of Glasgow; since then, the members of that association, with all their varieties of opinion, have passed one unanimous resolution—that, whatever system be adopted, the excreta must be kept out of the public sewers, the expression of a conviction which will be that of any patient enquirer into this difficult question.

In the paper referred to, I endeavoured to show that, whatever may be the best, the present water-closet system, with all its boasted advantages, is the worst that can be generally adopted; briefly, because it is a most extravagant method of converting a mole-hill into a mountain. It merely removes the bulk of our excreta

from our cities, to choke our rivers with foul deposit, and rot at our neighbours' doors. It increases the death-rate, as well as all other rates, and introduces into our houses a most deadly enemy, in the shape of the sewer gases.

Since then, the report of Messrs. Bateman and Bazalgette has appeared, and it proposes (what every one knowing the views of the authors would at once have predicted) to put down miles of costly sewers to carry the excreta to the Ayrshire coast, where, perhaps, the inhabitants may oblige us to take it back again; in other words, to commit the error of London, and wake up in a few years to the same bitter repentance.

We cannot be surprised at this; we cannot expect homœopathic treatment from an allopathic physician, especially if, as in this case, "bleeding" is to be again the universal cure. The engineer's treatment of town excreta always reminds me of the country doctor in America, who put all his feverish patients through a course of convulsions, because, though he didn't understand *fevers*, he *could* cure *fits*. In our numerous discussions, I have always maintained that chemists have been most unfairly treated in this matter. The public like to see what they pay for; they can see bricks and mortar, and therefore have allowed engineers to give them an intimate pocket-purse knowledge of this expensive commodity, for which they have paid in more than one sense—through the nose. Engineers have too fondly believed that water is the great purifier, and so they dilute the excreta with 365 times its bulk of water, and reduce its value to 1d. per ton, and then turn round on the chemist and expect him to reverse the process, pick out the penny, and repay the expenditure. Now, if it were a simple mixture—if it were only to separate the grain of wheat from the sack of chaff—the problem would be difficult enough; but we know the case to be far worse than this—it is the handful of yeast in the sack of flour that we are called upon to extract, and the fermentation of which we are expected to prevent, *after* it has occurred. A small portion of dilute sewage, mixed with a large excess of water, soon renders it all equally offensive, and the problem of extracting its value is one which no chemist need ever attempt to solve.

The water-closet, with many apparent advantages, and with all our prejudices in its favour, carries an attendant train of evils, which I am fully persuaded will ultimately doom it to oblivion.

As, therefore, engineers have not put the subject fairly before chemists, I propose to take a noble revenge, and put the subject fairly before engineers. I ask them why they consider water to be the only vehicle for removing excreta?—why not earth?—why not air? Have they ever fairly investigated or thoroughly experimented on the other methods? Have they not rather confined their studies to *fits*, and forgotten *fevers*?

So many attempts have been made by chemists to pick up the halfpence that engineers have so plentifully flung into the mud, that I cannot even notice them, except to remark that, in the opinion of all the scientific chemists who have specially investigated these attempts, they have all signally failed.

I must allude, however, to the process of Mr. Chapman, as one of the latest methods of dealing with town sewage; this is a process of distillation, after treatment with lime and thorough putrefaction. He, however, confesses his difficulty, by wishing to reduce the sewage of this city from 31,000,000 gallons to 1,000,000 gallons daily. This, of course, requires a complete alteration in the existing system, and it still dilutes the excreta with more than ten times its bulk of water. The lime process, and the putrefaction required to decompose the urea, would be extremely offensive, and require vast storing tanks. In working 1,000,000 gallons daily (it would more probably amount to 2,000,000 gallons); he would have to treat 4464 tons daily, the total chemical (not the extractible) value of which is 2s. 6d. per ton; and he expects to do this with 20 tons of coal. He proposes to adopt an ingenious arrangement of eight boilers, steaming exhaus-

* Especially when mangnesia is present.

† Read before the Chemical Section of the Glasgow Philosophical Society, April 19th, 1869.

tively, to distil off the ammonia, heating up the feed sewage, after precipitation by lime, by the hot water discharged from the boilers by a kind of brew-house refrigerator with its object reversed. He expects to distil off 1-12th; but I think it must be at least 1-10th, or 100,000 gallons, evaporated by 20 tons of coal = 5,000 gallons to 1 ton. The report of Professors Lyon Playfair and Johnstone puts the average evaporation for Scotch coal at 7.7 tons, or 1712 gallons per ton, and at this rate 58 tons would be required for the mere evaporation. Then, for raising the heat, the same report says that 1 ton of Scotch coal raises 56 tons of water from 32° to 212° F., or, say, 50 tons of water from 52° to 212° F., requiring, therefore, 96 tons for heating up, making a total of 148 tons a day. Mr. Chapman, therefore, expects to save, by heating feed water, and by exhaustive steaming, a total of 128 tons of coal daily, or 600 per cent. Can this be done? If it can, then whatever may be the result of his process, as applied to sewage, it will make him the greatest and most daring authority on that equally important subject, the economy of fuel. He puts down no loss for radiation. This should, I think, be at least 10 per cent, which would require nearly as much as his total calculated expenditure for fuel. In using eight boilers, of 4,000 gallons each, he expects to get off all the ammonia in half an hour's steaming. Now, we all know that the estimation of free ammonia in the laboratory is one of the most tedious processes, requiring a long-continued ebullition, and the experience of distillers, on the large scale, amply corroborates this, and proves that it does not pay to distil liquors containing under 1 per cent of ammonia (some manufacturers double this estimate). The total amount in the sewage to be distilled would be under 0.2 per cent; I think, therefore, that the process of Mr. Glassford, of evaporation with sulphuric acid (for which I must refer you to his pamphlet on London sewage), is better than this; fuel is the great question in both, but in his the results are certain, in Mr. Chapman's they are problematical.

Both are, however, connected with the water system, which I believe to be a mistake, and I think we must ultimately come, either to a system like Capt. Liernur's, by what may be called pneumatic despatch, or to the dry-closet system. Of the former I have fully treated in a former paper, and wish now to speak more particularly of the latter. During the past year, Moule's dry-closet has been largely introduced; all who have used it speak in the highest terms of its efficiency, and there are already strong indications of its becoming the system of the future. It is the only system that has succeeded during the hot fortnight at the Wimbledon meeting; and it is particularly adapted to hot climates, where the evils of the water-closet are most conspicuous. The objections urged against the system, when earth is used, are—1st, the large quantity of earth required—three and a half times the weight of the excreta; and, 2nd, the difficulty of obtaining the quantity required, and of drying it. Now, both these difficulties are disposed of by using charcoal. I employ, by preference, sea-weed charcoal, because it is the most porous, the best absorbent, and the cheapest. It only requires one-fourth of the weight, compared to earth; and when the mixture is removed and placed under cover, it soon dries. This mixture can be stored for any length of time, and used again several times. When convenient, it is re-burned, like the char in sugar refineries, except that this process is carried out in apparatus which admits of collecting the ammonia and other products condensed. The whole of the ammonia is thus collected; whilst the phosphoric acid, potash, and mineral matters accumulate in the charcoal, together with the carbon from the organic constituents of the excreta. The weight of the charcoal is increased to the extent of about 5 per cent with each using, and, if dried and re-used five times, about 25 per cent with each re-burning. With this constant addition, the char does not require replacing with fresh material, so that its cost is only a primary outlay—the ultimate result being that the excreta is deodorised by a charcoal derived

from itself, and a company working this process would, in addition to securing the whole of the ammonia, become sellers of a charcoal second only in value to that from bones to the extent of, in Glasgow, if the process were general, 19 tons a day, or 6,935 tons a year; the total quantity of excreta which Glasgow has to remove being 385 tons a day, and its value, at 29s. 6d. per ton, = £569.* The ultimate result being the same, any charcoal may be used at first. The process is carried out without odour, from the closets to the finished products. Of course the process may be modified; for instance, suppose the char to be used five times, and only dried, the addition to its value would be as follows (I take equal parts, as this charcoal will absorb at least an equal weight of even urine):—

1 ton seaweed char, at £2 } = 30 cwts. manure at £9 7s. 6d.
5 tons excreta, at 29s. 6d. } = £6 5s. per ton.

Or, if re-burnt, it would yield 25 cwts. of charcoal, and the whole of the nitrogen would pass over in the distillation, as ammonia. Dr. Wallace estimates the cost of re-burning ing char in sugar refineries at 3s. 6d. per ton for labour and fuel, containing 31 per cent moisture, which would be much over that referred to. Here, then, we have a simple process for recovering the whole of the value from excreta, of general application, and the results of which can be predicted by chemists with absolute certainty, as far as those products to which we at present attach value are concerned; but the uncertain portion is, as usual, the most interesting, for in the destructive distillation of excreta we are exploring a new field, which promises great interest.

I regret that I am obliged to bring this paper forward before the new products have been studied. The distillation generally is remarkably similar in its products to that of bones, and also to that, which most resembles it, of seaweed. Besides ammonia, acetic acid, with a little butyric acid, acetone, and pyrrol are the most marked bodies. I cannot speak more definitely of these products in this paper, as they are still under investigation. The following analysis of urine is taken from Miller, representing the average composition in 1,000 grs., sp. gr. 1.020. The calculated percentage of nitrogen is appended:—

Solid Matter, 43.20.				Nitro- gen.	In 100 parts of solid matter.	Nitro- gen.
<div> <div>Organic, 29.97.</div> <div>Inorganic, 13.35.</div> </div>	Water	956.80				
	Urea	14.23	6.64	33.00	15.40	
	Uric acid	0.37	0.12	0.86	0.27	
			6.76		15.67	
	Alcoholic extract .. .	12.53	=	29.03	=	
	Watery extract	2.50	=	5.80	=	
	Vesical mucus	0.16	=	0.37	=	
	Chloride of sodium .. .	7.22	31.86, or 31.18 per cent.	16.73	73.72.	
	Phosphoric acid	2.12		4.91		
	Sulphuric acid	1.70		3.94		
	Lime	0.21		0.49		
	Magnesia	0.12		0.28		
	Potash	1.93		4.47		
	Soda	0.05		0.12		
999.94				100.00		

NH₃ 8.2.

Sulphate of ammonia.

The average portion voided by each individual may be taken at 40 ozs., and of fæces, 4 ozs., total 44 oz. daily; or, 1.7 ozs., solid, from urine, and 1 oz., solid, from fæces = total of 2.7 ozs. solid excreta daily. The following analysis of the fæces is from Berzelius:—

Water	75.3	Solid matter, 24.7.	Containing, according to Playfair— 15 p.c. nitrogen, and 45 p.c. carbon, and about 25 p.c. ash. = nitrogen 3.75 p.c. = 4.55 NH ₃ . = 17.65 p.c. sulphate of ammonia. = 70.71 in dry solid matter.
Bile	0.9		
Albumen	0.9		
Extractive matter .. .	2.7		
Salts	1.2		
Insoluble residues of digested food	7.0		
Insoluble matters added in intestinal canal—mucus, biliary resin, and peculiar animal fat	12.0		
		100.00	

* Value given in my former paper.

The ash contains, according to Porter:—

	Ash of Fæces.	Ash of Urine (calculated).
Chloride of sodium..	1.33	54.15
Phosphoric acid ..	36.03	15.89
Sulphuric acid ..	3.13	12.73
Lime	26.46	1.57
Magnesia	10.54	0.89
Potash	6.10	14.45
Soda	5.07	0.38
Peroxide of iron ..	2.50	—
Carbonic acid ..	5.07	—

Assuming, then, the proportions voided to be in the proportion of 17 dry, from urine, to 10 dry, from fæces, the resulting chars may be expected to have the following composition:—

	Urine.	Fæces.	Mixed Excreta.
Percentage of char in dry } solid matter	50	70	57
Ammonia=sulphate ..	73.72	70.71	72.60

COMPOSITION OF CHARS.

	Per cent.	Per cent.	Per cent.
Carbon.. .. .	33.33	45.00	37.65
Chloride of sodium	36.10	0.33	9.51
Phosphoric acid..	10.60	9.01	10.01
Sulphuric acid ..	8.49	0.78	5.63
Lime	1.05	6.61	3.11
Magnesia	0.60	2.63	1.35
Potash	9.64	1.52	6.63
Soda	0.26	1.26	0.63
Peroxide of iron..	—	0.62	0.23
Carbonic acid ..	—	1.26	0.46

The nitrogen in the mixed excreta, in the proportions voided, is equal to 4.49 per cent of sulphate of ammonia.

In the char from urine, the phosphoric acid is principally combined with potash, and therefore soluble. This char alone would be a valuable manure as containing a large proportion of soluble phosphates; but the result of commencing with seaweed charcoal, which is rich in carbonate of lime, will be to form phosphate of lime at the expense of the carbonate—in other words, to form, by treatment with urine, re-burning, and washing, the animal charcoal required by the sugar refiner. This expected result is verified in the following tables of analyses. I regard the phosphate of lime thus gradually formed, from its minute state of division, to be quite equal, in agricultural value, to ordinary soluble phosphate. The washed residual char from fæces is at once available for the refiner, as it contains about 26 per cent of phosphates of lime and magnesia, with but a small proportion of carbonate. I know no reason why the product of disinte-

grated bone and muscle should not be used for this purpose as well as the bones themselves.

In distilling 100 tons of the dry product from mixed excreta, therefore, we should obtain 72 tons of sulphate of ammonia, and 57 tons of a charcoal containing 10 per cent of phosphoric acid in its most available form for manure, and 6 per cent of potash. It will be seen, from Berzelius's analysis, that nearly 50 per cent of the fæces consist of fatty matter—how will this appear in the distillation? In a population of 500,000, this item amounts to nearly 7 tons a day!

I expected a loss of ammonia in drying, but it is very small, and appears to arise from the free lime in the char, as it will be seen further on that the loss decreases in using the char with urine. In a small experiment with urine, I found the total loss, in drying by artificial heat with new char, to be 2.06 per cent of the ammonia, or 0.105 per cent of the urine employed.

I append analysis of 1 lb. of char which was re-burnt fifteen times with an equal weight of urine; a portion of the char was lost, which prevents my giving the increase in weight; I believe, however, the addition of carbon would be too slight to effect an increase in the total, with so many re-burnings. The percentage is decreased:—

	Char used.	After re-burning.	Increase per cent.
Water	10.0	2.80	—
Soluble salts ..	0.6	11.15	10.55
Insoluble	89.4	86.05	—

Soluble.

*Chloride of sodium..	—	8.75	8.75
Sulphuric acid ..	0.3	0.34	0.04
Phosphoric acid ..	—	2.00	2.00
Potash	0.3	2.40	2.10

Insoluble.

Carbon	54.4	29.40	—
Silica, &c... ..	9.1	13.10	4.00
Phosphate of lime ..	4.8	20.05	15.25
Carbonate of lime ..	17.4	19.75	2.35
Carbonate of magnesia ..	3.4	3.40	—

The urine used appears to have been deficient in sulphates and high in phosphates, these two ingredients being subject to considerable relative variation. The distillates gave 192 ozs. liquid, containing free ammonia equal to 3,047 grs. sulphate, or 2.9 per cent of the urine, showing a slight loss, inseparable from destructive distillations on the small scale. The charcoal should be used at least five times before re-burning, and for urine alone it may be employed ten times. I append a table, showing the analytical results of this process with urine:—

* In this and the following analyses, the whole of the chlorine has been calculated, for convenience, as chloride of sodium, which, in some cases, is therefore too high.

	Increase, per cent.				Increase, per 1,000 grs. of Urine.			
	1.	2.	3.	4.	1.	2.	3.	4.
Dry solid matter ..	33.30	62.50	210.00	347.94	33.30	31.25	42.00	34.79
Char	7.50	12.90	80.40	151.96	7.50	6.45	16.40	15.19
Ammonia sulphate ..	21.70	36.80	51.12	105.64	29.00	29.90	31.60	47.31

RESIDUAL CHARS.

		Composition, per cent.				Increase, per cent.				Increase, per 1,000 grs. of Urine.			
	Ordinary Char.	1.	2.	3.	4.	1.	2.	3.	4.	1.	2.	3.	4.
Water	10.00	1.60	3.00	—	—	—	—	—	—	—	—	—	—
Soluble salts	0.60	15.80	19.80	39.40	52.20	15.20	19.20	38.80	51.60	20.40	15.70	24.30	22.78
Insoluble	89.40	82.60	77.20	60.60	47.80	—	—	—	*41.60	2.04	23.90	19.60	12.47
<i>Soluble.</i>													
Chloride of sodium ..	—	5.40	13.10	28.02	24.70	5.40	13.10	28.02	24.70	7.18	10.60	17.30	11.06
Sulphuric acid	0.30	2.05	3.29	3.77	3.77	1.75	2.99	3.47	3.47	2.33	2.64	2.21	1.62
Phosphoric acid.. ..	—	2.20	0.40	trace	1.60	2.20	0.40	—	1.60	2.92	0.32	—	0.71
Potash.. .. .	0.30	2.80	4.99	7.00	10.38	2.50	4.69	6.70	10.08	3.32	3.89	4.10	4.62
<i>Insoluble.</i>													
Carbon.. .. .	54.40	37.40	40.00	35.40	28.20	—	—	—	*26.20	*4.50	5.30	11.06	7.19
Silica, &c.	9.10	13.60	10.00	8.00	4.40	4.50	0.90	—	*4.60	8.98	3.57	3.14	1.06
Phosphate of lime ..	4.80	8.00	9.60	11.40	10.20	3.20	4.80	6.60	5.40	5.84	5.40	6.10	4.08
Carbonate of lime ..	17.40	20.40	13.20	4.20	1.15	—	—	—	*16.25	9.73	2.00	*0.88	*1.22
Carbonate of magnesia	3.10	5.40	3.16	1.93	1.20	2.30	0.06	—	*1.90	4.08	0.98	0.57	0.23

* Decrease.

WASHED CHARs.										
Composition, per cent.							Increase, per cent.			
Ordinary Char.	1.	2.	3.	4.	1.	2.	•			
Carbon	54.40	45.30	51.80	58.40	59.00	*9.10	*2.60	4.00	4.60	
Phosphate of lime	4.80	9.60	12.40	18.80	21.34	4.80	7.60	14.80	16.54	
Carbonate of lime	17.40	24.60	17.10	6.90	2.40	7.20	*0.30	*10.50	*15.00	
Carbonate of magnesia	3.10	6.50	4.10	3.10	2.51	3.40	1.00	—	*0.59	

* Decrease.

No. 1 is from charcoal dried up with ten times its weight of urine before re-burning; No. 2 has been treated with twenty times its weight, No. 3 with fifty times its weight, and No. 4 with 100 times its weight of urine before re-burning. It will be seen, that in No. 4 more than the theoretical amount of ammonia is obtained; that from Nos. 1, 2, and 3 are obtained by simple destructive distillation. No. 4 only yields ammonia equal to 50.48 per cent of sulphate when heated in this way, the quantity given, 105.64 per cent, being that obtained with soda-lime; the residual nitrogen is not left in the char, but goes off in the distillation in some other form than ammonia. I shall recur to this subject in a subsequent paper. The retention of nitrogen after drying is, however, extraordinary, when the product yields ammonia equal to 105 per cent of sulphate. No Peruvian guano can be compared to this in fertilising value.

The washed chars acquire the composition which fit them eminently for the sugar refiner.

The experiments with closet excreta are unfinished, and it is difficult, in working on small quantities, to obtain uniform results. We find one of Smith's dry-closets use $\frac{1}{2}$ lb. of seaweed char per charge, the charge of dry earth being 2 lbs. Moule's closet uses rather less. There were seven uses in our first experiment, the contents of the pail being re-burnt at once, without drying.

Weight before distillation 130 ozs.

Residual char weighed 48 "

Weight of excreta 82 ozs. = 11.7 " per use.

The distillation gave 66 ozs. of gas liquor containing free ammonia = 2.8 ozs. sulphate = 3.4 per cent of mixed excreta; this represents only the free ammonia, or that existing as carbonate, a portion is combined with acetic acid, which was not estimated.

The same method is equally well adapted for treating pot ale from distilleries, and blood and offal from slaughter-houses. The former is an important subject in Glasgow, and I can, in this paper, only shortly allude to it. According to Dr. Wallace, one of the distilleries in Glasgow sends into the sewers 83,000 gallons of this pot ale, containing nitrogen equal to 118 grs. of ammonia per gallon; so that the daily discharge of this one distillery is equal to the total excreta of 48,970 persons, or one-tenth the population of Glasgow.

The process can be adapted with ease to urinals as well as closets. I am enabled to exhibit some mixtures of charcoal and night soil made twelve months ago. I was curious to know if these mixtures had gone further in the oxidation of the ammonia, and formed some nitrates, but not a trace can be detected.

I submit that the dry-closet system, with this process, has the following great advantages:—

1. Total freedom from all odour. All must have noticed sometimes the sickly odour of a water-closet, arising, not from the excreta, but from the gas from the sewers.

2. Certain prevention of all contamination and spread of infectious diseases arising from sewer leakage into our wells or sewer gas into our houses.

3. Saving of water, equal, in Glasgow, to £40,000 a year, if the water-closet system were general.

4. Saving of expense in repairs and removal. 1 cwt. of charcoal per month is sufficient for each closet when used by six persons daily, and the whole may be allowed to fall at once from the closet, through a 12-inch pipe, to a cesspit below the house. A cesspool is a serious evil, but I know of no evil to a cesspit.

5. By this process alone can the whole of the valuable material be recovered for our lands.

Dr. Fergus has shown some remarkable examples in which gastric fever has been traced to the escape of sewer gas through small openings eaten through the top of the soil-pipe. This appears to be a wide-spread evil. I have examined some of these specimens, and find the substance to be a sort of lead plaster, containing, also, lime and some fatty acid, which requires further examination. I have shown that only remedial measures can be adopted, where the water-closet system has been carried out, by placing boxes of charcoal in the closets, and filtering the sewage through charcoal before allowing it to enter rivers.

Our authorities want, of course, some grand scheme; but they forget that the question is one of minute details. We are assailed by a large army of small nuisances—one, at least, to every house, and we must attack them one at a time. Attacked in their united strength, they will assuredly overcome us. Ought we not rather to strike at the root of the evil? Ought we not to stop the mischief at its numerous sources, and before these can combine into a mighty force, which carries everything before it?

Let the subject be calmly and carefully discussed; let us not be carried away by great schemes and useless expenditure; let us not leave to posterity heavy taxes, with barren wastes and desolate cities, but let us rather pay our own way, and leave our country fertile and our towns pure, and I shall never regret that, however imperfectly this subject has been brought before you, my earnest wish has been to strike "one more blow for life."

A lively discussion followed the reading of the paper, the general opinion of the members of the section being highly favourable to the process, which was considered the most novel and practical which has yet been introduced.

NOTICES OF BOOKS.

Proceedings of the American Association for the Advancement of Science; Sixteenth meeting, held at Burlington, Vermont. Cambridge, U.S.: J. Lovering. 1868.

It will be new to some of our readers to hear that there exists an American Association for the Advancement of Science, corresponding to our British Association, and that the meeting which is chronicled in the work we are about to discuss is the sixteenth meeting of that association. The institution and support of such an association indicates a zeal for science among our American brethren which is surely a good omen, and a healthy sign of the times. Nothing more conduces to the spread of a love for science, and to the diffusion of scientific knowledge, a tutored scientific taste, and a *modus* of scientific thought, and nothing more encourages original research, than the banding together of scientific men for the one purpose of furthering each his individual study and pursuit. And what greater proof of this can be needed than that which Europe furnished in the seventeenth century? The downfall of Aristotelianism, and the consequent spreading love for the "new philosophy," did not culminate in, but almost started with, the rise of numerous scientific societies—the Accademia del Cimento, the Royal Society, the Collegium

Curiosum, and the Académie des Sciences, all appeared in less than half a century after the death of Bacon and Galileo. A period of great intellectual activity exists not without the blossoming and blooming of such institutions, and they react upon the period, and induce in it a greater charge of intellectual vigour. In a country like America, mighty in great works, the effect of such an association, if well supported, ought to be immense. We say "mighty in great works," because the opening of the Pacific Railway is yet in our minds, and, if there had not been some hundreds of eighth wonders of the world since the hanging gardens of Babylon were, with her "Babylon magna, mater fornicationum et abominationum terræ," razed to the ground, and since the Rhodian Colossus was broken up and sold as old brass, we think the Pacific Railway would be that eighth wonder. Perhaps the only work to be compared with it for extent and magnitude is that other among the ancient (and modern) wonders of the world, the Great Wall of China; let us, however, remember that the Suez Canal and the Mont Cenis Tunnel are approaching completion, and will soon have to be placed in the same category with the Pacific Railway. But we are plunging into a theme which, if extended, will bear us far from our present subject.

The subjects which engage the attention of the American Association for the Advancement of Science are thus divided:—A. (1) Mathematics and Astronomy; (2) Acoustics; (3) Physics and Chemistry; (4) Physics of the Globe (or, as we usually say in this country, Meteorology). B. (1) Geology and Mineralogy; (2) Palæontology; (3) Zoology.

The Association possesses a President, Vice-Presidents, Standing Committees, and Local Committees; and it appoints special committees for the discussion of special subjects. Among the latter we notice "a Committee to report in relation to uniform standards in weights, measures, and coinage." The address of the President (Professor J. S. Newberry), although short, gives a fair *resumé* of the dominant subjects of the day, in regard to both the philosophy of matter and the philosophy of mind.

The first paper which calls for our notice is by C. S. Lyman, of New Haven (Conn.), "*On a New Form of Wave Apparatus*." It is designed to illustrate waves whose "type is the ordinary ocean wave in deep water. The apparatus exhibits not only the wave profile, with its progressive motions, but also the motions taking place below the surface in the whole mass of liquid effected;" and it illustrates the wave theory established by Gerstner, Scott Russell, Rankine, and others. The apparatus could scarcely be described without the aid of a woodcut, but it somewhat resembles the wave apparatus invented some years ago, by Wheatstone (?) We frequently wish that some apparatus of this description appeared upon the lecture table, specially in lectures on light and sound. The subject of plane polarised light is difficult enough, in all conscience; what, then, shall we say to circular and elliptic polarisation? Surely, some means of visualising these actions might, with advantage, replace the black-board, and the old story of the wire grating and the card, and the ray of light with its *two sides*, an expression nearly as appropriate, we always think, as that about the two sides of a round plum-pudding.

In a paper entitled "*Tellurium a Metal*," Mr. L. Bradley adduces experiments and facts which compel him to regard tellurium as a metal. "It is true," he says, in conclusion, "that tellurium is not malleable, nor ductile, as are many of the metals; neither is bismuth nor antimony. Like the non-metallic substances, it unites with oxygen to form acid; so do antimony, arsenicum, gold, chromium, manganese, and many other metals. With hydrogen it unites to form a hydruret; so do potassium, arsenicum, and antimony. In short, it possesses the universally-admitted distinguishing characteristics of metals, and nothing either in physical character or chemical behaviour which it does not hold in common

with some other metals. I must, therefore, call it a metal."

We come now to a paper entitled "*Chemical Diagrams and Derivative Symbols, Illustrating the Prominent Characteristics of Chemical Elements*." Here we are introduced to a species of diagram appertaining more to heraldry than to chemistry, albeit, there is a touch of alchemical mysticism introduced. They are, for the most part, a sort of half-bred between John Rudolf Glauber's three enigmatical designs and the illustrations to the article "Heraldry" in Chambers's old "Encyclopædia." What have we here? A black triangle; along the sides of which the words carbon, boron, and silicon appear, the whole surrounded by a shield. Here, again, is a shield, "simple," bearing a triangle, "proper," on a field, "argent." In the next diagram, the triangle has burst out eruptively, and is vomiting forth small jets of bromine, sulphur, tellurium, &c. The mysticism is obviously on the increase; is this a treatise *De Secretis* of the Middle Ages? At least, we recommend the author to peruse the "*Pretiosa Margarita Novella*." But what is this shield with a bar sinister? Have we illegitimate compounds in chemistry? If so, we rather imagine that pseudomorphs ought to be ranged under this head. A greater wonder yet remains: the author proposes to designate lithium, sodium, potassium, rubidium, and cæsium by a star with five points. He is, perhaps, unaware that the precise star which he has drawn is used in heraldry to designate a third son. Now, to say that a third son in heraldry, and five alkaline elements in chemistry, are symbolically the same, is palpably absurd. *Q. E. D.* And we are bound to confess that we must apply the same mode of argument to the whole of the paper. We would beg to suggest to the author the term "Heraldic Chemistry."

This paper is followed by another by the same author, on "*A New Chemical Nomenclature*;" and here his mystical longings crop up again with renewed vigour. The terms of the nomenclature are mystical, heathenish, barbarous—shall we add insensate? Without a doubt, they are closely related to the words wherewith, in former ages, many have tried and some have hoped to raise the devil. What shall we say to *kalamalt*, *nobamet*, *tanamet*? The "acid chromate of sesquioxide of chromium" rejoices in the name of *chreamyt*. The bromide of ammonium is *olanab*; sulphate of soda *natemasot* [happily, poor Glauber is dead], while chloride of sodium becomes *sodamad* (and we do not wonder at it, after such treatment). One more example, and we have done. "Bihydrochlorate of bibromoterchloronaphthaline" is to be called *eurulebod*, a term which must originally have been suggested by a Regius Professor of the language of the Feejee Islanders. The cardinal question yet remains. Whence comes this jargon? and what does it mean? We cannot tell, unless it is the production of that wonderful book-composing machine used by the Laputan philosophers, which took in letters and turned out completed books, in any language and on any subject; and we would venture to remind our author that hard by, was a philosopher, who proposed to build houses from the roof downwards, beginning with the chimney-pots. In all seriousness, we say to the author of this paper, seek rather to discover new chemical facts than to generalise upon those already discovered; avoid mysticism, give up heraldry and bars sinister, and, above all, remember a very pertinent passage in the "*De Augmentis Scientiarum*" (and does not the title-page say "The American Association for the Advancement of Science?"), in which Bacon says with great felicity, "*Quocirca non certæ magis experientiæ quam rectæ etiam rationi consonum videtur, ut res ponatur doctrinarum intemperies. Prima est doctrina phantastica, secunda doctrina litigiosa, tertia doctrina fucata et mollis: vel sic; vanæ imaginationes, vanæ altercationes, vanæ affectationes.*"

It only remains for us to say that the work we have considered contains several admirable papers, and that we wish all success to the "American Association for the Advancement of Science."

LABORATORY NOTES.

LABORATORY PUMP.

I FORWARD a description of a slight addition which I have devised to the valuable filter pump of Professor Bunsen, whereby the filtrate, if required, may be retained for further research.

Take an ordinary bell-glass receiver used in collecting gases, open and ground at the bottom, and closed at the neck with a stopper. Remove the stopper, and replace it by a cork, through which passes the funnel and exhausting tube, as shown in the flask in Professor Bunsen's arrangement. The receiver can then be placed on a glass plate, a beaker introduced within it, and the joint between the receiver and the plate made good with a little tallow. The funnel should be lengthened by fusing a piece of glass tube to it, so that it may reach half way down the beaker, as the liquid dropping from the funnel in the rarefied medium is very apt to splash upwards.

JOHN DODS.

Laboratory, Crewe Works,
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CORRESPONDENCE.

MAWSON AND SWAN'S LABELS.

To the Editor of the Chemical News.

SIR,—A thorough revision of the new Book of Chemical Labels, published by Messrs. Mawson and Swan, of Newcastle, has led to the discovery of three obvious errors of the press, which, I trust, you will permit me to point out. In the labels for Barium and Calcium Chlorides, the modern formulæ are printed as BaNO_3 and CaNO_3 respectively, instead of $\text{Ba}(\text{NO}_3)_2$ and $\text{Ca}(\text{NO}_3)_2$, and in the table of combining weights, the old number for Silicon is erroneously given as 14 instead of 28. By a singular mischance, one of the incorrect labels has been taken as a specimen for the publishers' advertisements. The indicated errors, which may be easily corrected by the pen, do not appear in the copies of the work which are now being issued. The fact that only three mistakes are discoverable in a long series of formulæ may, perhaps, be deemed satisfactory evidence of careful compilation by those who have published chemical works, but after the precautions taken to insure correctness and consistency, even these few errors suffice to disturb the equanimity of

THE EDITOR OF THE BOOK OF LABELS.

London, June 16th, 1869.

QUANTIVALENCE.

To the Editor of the Chemical News.

SIR,—The only apparent objection to the word quantivalence as a substitute for the expression atomicity is that mentioned by "C.H.," namely, that Naquet uses the latter term to indicate the maximum, and the former the varying saturating power of an element. Such limitations, however, are entirely unnecessary, and have not received general acceptance. Surely we may attack or defend the notion of constant against varying atomicity, otherwise synonymously termed quantivalence, without inventing special words or engaging in the vain endeavour to give to existing words fresh meanings in violation of etymology. Besides, if the question is to turn on priority, quantivalence was, I believe, originally offered by Hofmann as the pure equivalent of atomicity.

So much for the name; now for the subject. As a

teacher of chemistry to large classes of students, I have found the doctrine of quantivalence of immense value to learners. At first, following good leaders, I treated radicals as if possessing, but not always exerting, constant quantivalence; latterly the one or two prevailing values of the (chemical) atom of the common elementary or compound radicals have been pointed out, the hypothesis of the self-contained or "latent" affinities of an atom being suppressed. This is the position I intend occupying until more evidence is forthcoming.

Reverting to the word. We recently heard one learned lecturer utter the barbarism monovalent, giving the accent to the last syllable but one; another speak of the barbarism pentavalent, also accenting the penultimate. I believe we simply follow rule in emphasising the third syllable from the end in the case of each of the words u-niv'-a-lent, biv'-a-lent, triv'-a-lent, quad-riv'-a-lent, quin-quiv'-a-lent, sex-iv'-a-lent. This matter is worthy of reference, inasmuch as, amongst other reasons, euphonious words are the most acceptable—quan-tiv'-a-lence has a better chance of employment than quan-ti-va'-lence. Taking for guidance the pronunciation accorded to the old word e-quiv'-a-lent, there need be no difficulty in this matter.—I am, &c.,

JOHN ATTFIELD, Ph.D.,

Professor of Practical Chemistry to the
Pharmaceutical Society.

MISCELLANEOUS.

Memorial to Faraday.—A public meeting, at which H.R.H. the Prince of Wales will take the chair, will be held at the Royal Institution on Monday next, June 21st., at half-past 3, to consider the measures to be taken for the promotion of a memorial to Faraday.

Proposed New Physical Society.—It has been proposed to establish a Physical Society in London, and already many promises of support and proposals for membership have been received. We shall be glad to receive the views and opinions of our readers on this subject.

The British Association.—At a meeting of the council, on Saturday last, Sir Roderick Murchison in the chair, it was reported by the General Secretary that the following Presidents of sections had consented to preside at the Exeter meeting. The following Vice-Presidents were nominated:—Section A (Mathematical and Physical Science).—President, Professor Sylvester, F.R.S.; Vice-Presidents, Professor Adams, F.R.S., and Mr. W. R. Grove, Q.C., F.R.S. Section B (Chemical Science).—President, Dr. Debus, F.R.S.; Vice-Presidents, Professor Odling, F.R.S., and Professor Williamson, F.R.S. Section C (Geology).—President, Professor Harkness, F.R.S.; Vice-Presidents, Mr. R. Godwin-Austen, F.R.S., and Mr. W. Pengelly, F.R.S. Section D (Biology).—President, Professor Rolleston, F.R.S.; Vice-Presidents, Mr. C. Spence Bate and Mr. E. B. Tylor. Section E (Geography).—President, Sir Bartle Frere; Vice-Presidents, Sir George Grey, K.C.B., and Mr. A. G. Findlay, F.R.G.S. Section F (Economic Science and Statistics).—President, the Right Hon. Sir Stafford H. Northcote, M.P.; Vice-Presidents, Mr. T. D. Acland, M.P., and Colonel Sykes, M.P., F.R.S. Section G (Mechanical Science).—President, Mr. C. W. Siemens, F.R.S.; Vice-Presidents, Mr. G. P. Bidder, F.R.G.S., and Mr. C. Vignoles, F.R.S. The Mayor of Exeter, Sir Stafford Northcote, and Sir John Bowring were present, and supported the application of the working men for a special lecture during the meeting, which was unanimously agreed to, and subsequently Professor W. A. Miller, Vice-President and Treasurer of the Royal Society, was invited to undertake the duty.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we are endeavouring to effect arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 8, May 8, 1869.

We notice, in the brief report of the general meeting of the 26th of April last, under the presidency of Professor A. W. Hofmann, that the Committee of this Society had arranged and approved of the proposal of M. Scheibler, that a photographic album be made to contain the photographic portraits of the members of the *Gesellschaft*, taken in the well-known card size, and each photograph to bear, moreover, the autograph of the member it represents. At the ordinary meeting of the Society, held on the same day, the following papers were read:—

Simple Method for Determining the Percentage of Water contained in Various Kinds of Starch.—M. C. Scheibler.—The author states that he had been requested by a number of starch and glucose manufacturers to try to find a readily-executable, yet reliable method of determining the quantity of water contained in starch, especially in its green, or raw state. M. Scheibler further says, that it occurred to him that, since starch is insoluble in alcohol, and only contains very slight traces of fatty matter, the object to be obtained might be readily attained by determining the change of the specific gravity alcohol suffers after having been for a length of time in contact with wet starch. In order to test this point practically, some preliminary experiments were first made with starch and alcohol of 90° Tralles (equal to 0.8339 specific gravity at 12.4° R.), and afterwards the following mode of testing was devised:—100 c.c. of the alcohol, weighing 83.4 grms., were placed in a glass-stoppered bottle, and thereto was added 41.7 grms. of divers samples of starch, in separate samples, of which the quantity of water therein contained had been previously ascertained with great accuracy. These samples were left in contact with the alcohol for one hour, care being taken frequently to shake the bottle. After that lapse of time, the alcohol was separated from the starch by filtration, and its specific gravity accurately determined. While experimenting, the author observed that, when the starch contains less than 11.4 per cent of water, instead of yielding up water to alcohol of the above-named strength, it withdrew water from that alcohol. The lengthy paper contains several tabulated forms, and is, on the whole, intended especially to aid starch and glucose makers in their business, and the experiments refer to so-called green starch.

Essay on the Affinity in Solutions of Perchloride of Iron, without Change of the State of Aggregation.—M. A. Müller.—The author says, in the introduction to his paper:—Only when the intensity of a coloured solution decreases, by dilution, in the inverse ratio of the increase of bulk, are we entitled to assume that the molecules of the colouring material are simply mechanically put asunder, and not also chemically modified; when, however, the intensity of colour is affected, in a more or less degree, in a different manner, by becoming more dilute, we are almost forced to assume a chemical change. The author next states that, from experiments made by him, and with solutions of chloride of iron and other coloured metallic chlorides, platinum chloride being preferred, he has found that the intensity of the colour of the solution really depends—1st, on the nature of the diluent; 2nd, on the temperature of the solution; and, 3rd, on the age of the solution—i.e., whether recently prepared or not. As diluents, have been applied—water, hydrochloric acid, solution of chloride of ammonium, and solution of chloride of sodium. The experiments made are described at great length. It appears that the addition of hydrochloric acid, chloride of ammonium, and chloride of sodium have the effect of increasing the intensity of colour of a solution of chloride of iron, even after it has been largely diluted with water; increase of temperature has the same effect.

Varying Behaviour of Iodine towards Sulphuretted Hydrogen under Different Conditions, and the Causes thereof.—M. Naumann.—When iodine is dissolved in perfectly anhydrous sulphide of carbon, and dry sulphuretted hydrogen is passed into that solution, no action whatever takes place. Water, as well as an increase of temperature, are required for the formation of hydriodic acid and the separation of sulphur. The author has gone at great length in studying both the thermic and hydric conditions, which are called into play when the two substances alluded to react upon each other; and, in the second part of his paper, discusses—

The Preparation of an Aqueous Solution of Hydriodic Acid.—Several experiments have been made on this subject, and, as result thereof, the author recommends that, first, a concentrated solution of iodine in pure sulphide of carbon be made; this solution to be next diluted with more of the latter fluid, and then only water to be

added, previous to the passing of sulphuretted hydrogen gas into the solution.

Essential Oil of Balsam of Peru.—M. Kraut.—The author found that this oil may be separated, by distillation under reduced pressure, and in an atmosphere of carbonic acid gas, into three different oils:—*a.* Boils at 200° C.; contains 76.25 per cent C, and 6.68 per cent H; and is converted, by chromic acid, into benzoic acid, no carbonic acid becoming disengaged. *b.* Boils at 300°; contains 79.09 per cent C, and 6.00 H; an alcoholic solution of potassa converts this oil into benzoic acid and benzylic alcohol. *c.* Boils at about the boiling point of mercury; contains 81.21 per cent C, and 6.12 H; treated with alcoholic solution of potassa, it is converted into cinnamic acid and benzylic alcohol.

On Cumonitrilamine.—M. E. Czumpelik.—The author describes at great length a series of experiments made by him to prepare this base; the description being too complicated for abstraction, we content ourselves with giving the ultimate result of his labours. Cumonitrilamine is a solid substance, readily crystallising, difficultly soluble in water, but readily so in alcohol and ether; fuses at 45° C.; and boils at 305° C. With acids, salts are formed, and with chloride of platinum a beautifully-crystalline double salt is obtained. The elementary organic analysis of this salt gave, in 100 parts, the following result:—C, 32.74; H, 3.54; N, 7.68; Pt, 26.97; Cl₆, 29.07. These numbers lead to the following formula:—



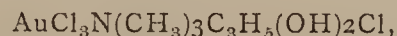
The equivalent of this platinum compound is 733.

Base of the Cumin Series, which agrees with Benzylamine.—M. E. Czumpelik.—In this paper, the author tells us how he effected the hydrogenisation of the cumonitrile. While obtaining various intermediate products, he at last got thioamide, an oily liquid, yielding, with hydrochloric acid, a readily crystallisable salt, which combines with chloride of platinum, yielding a crystalline compound, insoluble in water, and soluble in alcohol and ether. This, on being submitted to elementary organic analysis, gave the following results for 100 parts:—C, 33.78; H, 4.15; N, 3.94; Pt, 27.18; Cl₆, 29.95. Formula—



The equivalent of this platinum compound is 711.

On Trimethylglycerammonium.—M. V. Mayer.—By a complicated set of reactions between substances, the very length of the names of which would occupy too much space. The author succeeded in obtaining a double gold salt of the base named at the head; this salt—



that is to say, the trimethylglycerammonium chloride of chloride of gold exhibits orange-coloured, very lustrous crystals, soluble in water, as well as in absolute alcohol, and fuses at 190° C. The trimethylglycerammonium chloride is a solid substance, crystalline, soluble in water, and decomposed, by boiling with baryta water, into trimethylamine. The author states that his researches on the trimethylglycerammonium, in free state, are not yet quite complete.

On the Means of Entirely Preventing Bumping of Fluids while Boiling.—M. E. Winkelhofer.—The author reviews what has been done by others, and especially by Dr. Pellogio, and next describes, at length, some experiments of his invention, embracing the following fluids:—Methyl-alcohol, sulphuric acid, alcoholic solution of sulphate of protoxide of iron, alcoholic potassa solution, hydrochloric acid, and dilute sulphuric acid, containing some sulphate of lead. His plan, to prevent bumping, is simply an electric current, led into the fluids by means of suitable conducting wires; his contrivances are very ingenious, but certainly too complicated for general use.

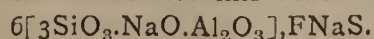
Hypotheses respecting the Constitution of Benzol.—This paper cannot be well understood without the diagrams annexed thereto, upon the value of which the reasonings contained in the paper are based.

This number of the *Berichte* concludes with a brief notice, by M. Rammelsberg, correcting some of Mr. Maskelyne's statements in respect of a meteorite and minerals found therein, and the specific gravity of these minerals. Maskelyne observed in a meteorite from Breitenbach in Bohemia, occupying a middle place between iron and stone meteorites, a mineral embedded in the iron, of 3.3 sp. gr., and having the composition of enstatite. He found another mineral, which yielded, on analysis, from 97 to 99 per cent of silica, and only having the low sp. gr. of 2.1 to 2.2, and is therefore not quartz; Maskelyne says it is optically doubly axial, and takes it as identical with tridymite, which, however, has a sp. gr. of 2.3, and is optically uni-axial.

Der Papier Fabrikant, No. 5, May, 1869.

This periodical, published in Southern Germany, is not a mere trade circular, but a very well got up paper; and, in the present number, an interesting paper is met with on a subject not quite familiar to scientific, and less so to many practical readers, in this country. We abstract some of the leading features of a valuable paper—

On Ultramarine.—M. Zuber.—The beautiful blue pigment now known as ultramarine, and manufactured in France and Germany on a large scale, has become common by the results of scientific and analytical chemistry. The native ultramarine, also called lazulite, lapis lazuli, and zeolite blue, is a rather rare mineral, of which, in pure state, according to Patrin, Central Asia is the native place. This native mineral consists, in 100 parts, according to Varrentrapp's analysis, of:—Silica, 45.40; alumina, 31.67; soda, 9.09; lime, 3.52; sulphuric acid, 5.89; sulphur, 0.95; iron, 0.52; chlorine, 0.42; water, 0.12. According to Field, the formula for this mineral is—



The finest specimens of native ultramarine are used as precious stones; and some of it is still used by artists, it being prepared for that purpose, in a peculiar manner, chiefly at Rome and Florence. Artificial ultramarine was first made by a process discovered by M. Guimet, in France, in 1826, but kept secret, and remaining so up to the present day. Although the pigment obtained by artificial means is one of great beauty and permanency, under ordinary conditions it is never made equal to the pigment derived from the native *lapis lazuli*. Notwithstanding a large number of scientific and practical men have studied this subject, the precise answer to the question, whence the blue colour of this substance is derived from, is a perfect mystery; the only fact certainly known is, that a portion of the sodium is combined with the sulphur, to form a certain sulphuret, and that that alkaline sulphuret is chemically combined with a double silicate of alumina and soda. Iron and calcium have been proved to have nothing to do with the cause of the blue colour, and to be simply accidental. In the original paper, from which we condense the results, no less than 10 analyses of samples of artificial ultramarine, made by different analysts, and from different makers, are given. Varrentrapp's results are, for 100 parts, as follows:—Silica, 46.60; alumina, 23.30; soda, 21.46; sulphur, 1.68; potassa, 1.75; iron, 1.06; lime, 0.02; sulphuric acid, 3.08; with traces of chlorine, oxide of iron, oxygen, and an accidental trace of clay. The ingredients required for the manufacture of artificial ultramarine are—sulphur, wood charcoal, sulphate of soda, carbonate of soda, and kaolin; curiously enough, the latter substance is preferred from Cornwall, and fetched thence to be transported abroad, while the manufacture of ultramarine in this country is of little or no importance. The product of ultramarine met with in commerce is rarely, if ever, adulterated, unless it be with the pure sulphates of lime and baryta, to reduce the original deep blue colour to a less dark shade. In order to test the colouring value of a sample of ultramarine, it is usual to weigh off 0.1 grm., and to mix it, in a dry state, with 1 grm. of powdered French chalk, and to compare the tinge obtained with other mixtures of the kind and a standard sample of ultramarine. Besides being largely used in oil painting, ultramarine yields blue printing ink, blue for calico, silk, and woollen tissues; for colouring paper, sugar (it is largely used in sugar refineries to brighten the loaf sugar), fresco and stucco painting, and other purposes. All acids, especially the more concentrated ones, destroy the colour, which, however, stands fire, as well as many other agents. The native ultramarine is not affected by acids unless heat is at the same time applied.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, February, 1869.

None of the papers contained in this periodical bear upon chemical science, or subjects more immediately connected therewith.

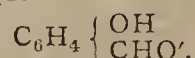
Annalen der Chemie und Pharmacie, May, 1869.

This periodical contains the following original essays and papers:—

On Indium.—M. R. E. Meyer.—The author opens this lengthy essay with a review of the labours of others on this subject. He then states that the source whence he extracted indium is the zinc from Freiberg, in Saxony. The preparation of the metal, and its purification, are described at great length, but, since no new method was applied, we need not enter into details on this subject. The various combinations of this metal with iodine, bromine, chlorine, cyanogen, sulphuretted hydrogen, and, next, salts of the oxide, are described. The iodide of indium, InI_2 , equivalent 329.6, contains, in 100 parts:—Indium, 22.94; iodine, 77.06. The chloride of indium, InCl_2 , equivalent 146.6, contains, in 100 parts:—Indium, 51.57; chlorine, 48.43. A large number of double salts and compounds of the halogens of indium, with similar compounds of other metals forming double halogen compounds, are described in detail; in fact, the essay is an exhaustive monograph on this subject.

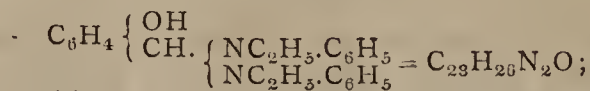
On Lactic Acid and β Iodpropionic Acid.—M. Socoloff.—This essay is a review, rather of what has been done on this subject by other experimenters, than an account of the author's own labours. He states that the β iodpropionic acid was prepared by him in the same manner as was done by MM. Beilstein and Moldenhauer. Several salts of this acid were prepared by M. Socoloff, and submitted to organic elementary analysis. The calcium salt yielded, in 100 parts:—Carbon, 33.08; hydrogen, 4.62; calcium, 18.34; the remainder being oxygen. In a tabulated form, the author records the physical properties of the calcium, barium, zinc, and lead salts of the acid submitted to research by him, and of ordinary lactic acid, paralactic acid, and methylglycolic acid. The lengthy essay winds up with a theoretical discussion on mono-acid, bin-acid, and even hepta-acid alcohols.

Researches on the Derivatives of Salicine.—M. Hugo Schiff.—This paper is the first of a series to be continued by the author on this subject, and this portion is headed—1. *Amide of Salicyl Aldehyde*. The author begins by stating that the formula for the aldehyde of salicyl should be written—

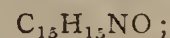


Next, the preparation of this aldehyde is described as follows:—Take, from 300 to 400 grms. of salicine, and the Ettling oxidation mixture (nothing is said as to what this mixture consists of); during the time the distillation is going on, water is allowed to drop continuously into the retort, in order thereby to keep up the original degree of concentration of its contents, and to prevent the formation of resin as much as possible. The aldehyde, after having been separated from the water, is saturated with common salt, and mixed with ether; in this manner, about one-third of the weight of the salicine originally taken

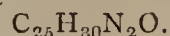
is obtained as aldehyde. The author next treats of the products of the action of aniline upon salicyl-aldehyde, and then describes, at great length, several complicated combinations, as, for instance, sal-hydr ethylanilide, formula—



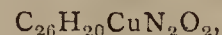
ethylsalhydranilide—



and ethylsalhydr ethylanilide—



Several metallo-compounds are next described—Copper salhydranilide—



containing, in 100 parts:—Carbon, 68.2; hydrogen, 4.6; copper, 13.7.

Derivatives of Propane.—M. Carl Schorlemmer.—Propane, a hydrocarbon, C_3H_8 , is described, first, as regards its preparation from isopropyl iodide and zinc turnings; next, a chloride of propane is prepared, which, on being analysed, yielded results leading to the formula $\text{C}_3\text{H}_7\text{Cl}$. The author describes several experiments, made with the view to obtain chemically pure products, and ends his paper by promising more accurate and full details on this subject.

On Hydroxylurea.—Drs. Dresler and Stein.—When hydroxylamine and cyanic acid act upon each other, a substance is obtained, the composition of which may be expressed by the formula $\text{N}_2\text{CH}_4\text{O}_2$. The authors state how they proceeded to obtain this substance, in a pure state, by a rather complicated and lengthy process. The hydroxylurea is a solid substance, very soluble in water, sparingly in alcohol, crystallising in needle-shaped crystals; it fuses at 130°C ., and is decomposed when that temperature is continued, yielding carbonic acid and ammonia. The substance is readily acted upon by caustic potassa and nitric acid; its solutions, in neutral fluids, reduce solutions of salts of silver to the metallic state.

Comptes Rendus des Séances de l'Académie des Sciences, Monday, May 31, 1869 (No. 22).

We notice, in the first place, an abstract of a memoir—

Decomposition of Chloride of Sodium and Chloride of Potassium by Metallic Iron under the Influence of Moist Air.—M. E. Chevreul.—After having entered upon some historical details, and gone back as far as the year 1779, when Scheele experimented on this subject, he proves, by a simple experiment made before the meeting, that, when chloride of sodium, iron, water, and air are in actual contact, decomposition of the alkaline chloride takes place; further, that this decomposition is not, as has often been stated, an effect of efflorescence, but a double decomposition, according to the well-known law of Berthollet, which, however, was rather too vaguely formulated by its original author.

New Spectrum Observations of the Sun's Atmosphere and Protuberances.—Rev. Father Secchi, S.J.—In the shape of a letter, addressed from Rome, and dated May 21st, the eminent *savant* states:—The spectrum observations of the solar protuberances made by M. Rayet, during the eclipse of the sun, in the month of August last year, have revealed a considerable number of luminous rays, seven of which were especially prominent; only four of this number have afterwards, when no eclipse takes place, been found to exist with certainty—viz., the three principal rays of hydrogen, and the yellow ray in the neighbourhood of sodium. It was highly interesting to try whether, under favourable conditions, these three other rays could be again found. I am happy to be able to state that, during my observations yesterday (May 20th), I have succeeded in seeing these rays with perfectly absolute certainty. The author proceeds to describe the exact locality where he discovered these rays, and gives a diagram to illustrate this portion of his letter; and next describes the nature of these rays at length, illustrated by a diagram. It appears, from this description, that the rays exhibit great brilliancy, and are more remarkable, even than could be expected at first from M. Rayet's former observation. The rays are those of magnesium, hydrogen, and a non-gaseous (as yet undetermined) substance.

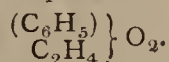
Scientific Aerostation.—M. Tissandier states that a balloon, of 10,000 cubic metres (about 354,000 English cubic feet) capacity, and of 2500 square metres surface, has been placed, by M. le Ministre de la Guerre, at the disposal of several scientific men, and that it is intended to have (on June 27th and July 11th ensuing, from the Champs de Mars, Paris) ascents with this balloon, the car of which is capable of carrying with comfort ten people, and, in addition, 1500 kilos. weight; members of the Academy desirous of being of the party are requested to state so. This balloon is formed of four layers of tissue, glued together by means of india-rubber, and is to be filled with hydrogen; and experiments already made have proved that it preserves that gas unaltered for a long time.

On a New Thermo-Electric Battery made with Galena.—MM. Mure and Clamond.—This battery is composed of sixty elements, made up of small bars of galena, 40 m.m. in length by 8 m.m. thick, and bars of thin sheet iron, 55 m.m. in length by 8 m.m. in width, and 0.6 m.m. thickness. These materials have been arranged so as to form a hollow cylinder, which, when it is intended to be used, is to be heated by a peculiarly constructed gas burner. The specimen of this battery exhibited at the meeting had an electro-motive force of 1½ Bunsen element. M. Becquerel read a lengthy paper on the subject of this battery, the result of which is, that thermo-electric batteries, constructed either of metallic alloys, or as in this case, of a metallic sulphide and a metal, are not economical in use, and are too liable to changes brought on by the effects of the heat.

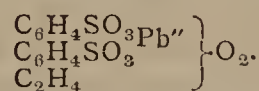
The Law of Mariotte, and on the Liquefaction of Gases in Relation to the State of Dryness of these Gases.—M. Dubrunfaut.—Curiously enough, in spite of, and against all evidence to the contrary, the author insists that perfectly pure and dry gases cannot be liquefied by any pressure or any lowering of temperature, however great. He says, the intervention of water is an absolute condition of the condensation of gases to fluids; no wonder that M. Dumas should vehemently protest against a heresy so flagrantly in opposition with experience.

Chemical Constitution of Amylaceous Matter.—M. Musculus.—The author has made a series of experiments, in order to prove that the formation of dextrine from starch is only the first step in the process of splitting up which starch undergoes when it is placed in contact with water and diastase at a temperature of from 60° to 75° C., and that the quantity of sugar obtained by this process represents at least two equivalents. The lengthy paper contains the results of a series of experiments, too long and too many to be further quoted here, but the author has to confess that his main object has not been attained.

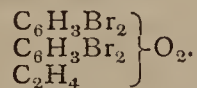
Researches on the Ethers of Phenol.—M. E. Lippmann.—The author has studied—*Ethylen-diphenol*—



Ethylen-diphenolsulphuric Acid.—The lead-salt of this acid crystallises, and is soluble in hot water, but insoluble in cold water. The analysis of the salt, dried at 120° C., gave, in 100 parts—C, 29.49; H, 2.0; Pb, 35.7. Formula—



Ethylen-diphenosulphate of barium. A crystalline powder, not very soluble in boiling water. Its elementary organic analysis gave, for 100 parts:—C, 33.0; H, 2.3; Ba, 26.9. Tetrabromide of ethylen-diphenol is composed, in 100 parts, of:—C, 31.6; H, 2.0; Br, 60.3. Formula—



The author states that the preliminary note from M. Burr on this subject, published in the *Zeitschrift für Chemie*, No. 6 (see CHEMICAL NEWS, vol. xix., p. 251), had not come into his possession when he made his experiments.

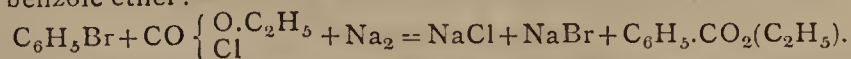
New and General Method for the Preparation of Nitriles.—M. L. Henry.—The author has succeeded in transforming amides into nitriles, by means of pentasulphide of phosphorus, and has especially operated upon acetamide and benzamide, making use of 1 equivalent of the pentasulphide of phosphorus upon 5 equivalents of the amide. The result of the action of the pentasulphide of phosphorus upon acetamide is aceto nitrile, (C₂H₃)N; while the result of the action of this material upon benzamide, is cyaphenine, a polymere of benzonitrile, (C^{'''}H₅)N.

Physiological Effects of Stanethyl and Stanmethyl.—MM. Jolyet and André Cahours.—The authors describe the preparation of these chemical compounds, which may be obtained by means of the perchloride of tin, Sn₂Cl₄, at great length, and then describe the physiological effects, which are those of stupor, inducing narcotism in the very highest degree.

No. 23, June 7, 1869.

We notice, from this periodical, the following memoirs, papers, and communications, omitting those relating to physiology, medicine, mathematics, and mechanical science:—

Synthesis of the so-called Aromatic Acids.—M. Wurtz.—The author describes, in the following terms, a new method for the synthesis of the above acids:—When an organic chloride, or bromide, is treated with chloroxycarbonic ether and sodium amalgam, the haloid element is eliminated by the sodium, and replaced by the group CO₂(C₂H₅); if it is, therefore, required to convert a carbide of hydrogen into a higher monocarbon acid of the series, the monochloride or monobromide of that carbide of hydrogen is first prepared, and then heated with chloroxycarbonic ether and sodium amalgam. The author next proceeds to describe some experiments made by him, and the results obtained, at length; starting with bromide of phenyl, C₆H₅Br, and mixing this chloroxycarbonic ether and sodium amalgam, the following formula represents the reaction, resulting in the formation of benzoic ether:—



Use of the Spectroscope to Distinguish a Feeble Light, Present with a Stronger Light.—M. Seguin.—The author describes a series of experiments with electric light, and observations thereon with Duboscq's vertical spectroscope. The result and conclusion arrived at is, that the spectroscope serves eminently the purpose of detecting (proved, also, by the observations made with it of the sun's light and protuberances) a more feeble light present along with a much stronger, and the former of which would be invisible to the naked eye, or by means of other optical instruments.

On Acetochlorhydrine and Octylglycol.—M. de Clermont.—Into 50 grms. of anhydrous acetic acid, strongly cooled, anhydrous hypochlorous acid is passed, until the acetic acid has absorbed 10 grms. of the latter; no stronger solution should be made, as there is danger of explosion. To the mixture of acetate of chlorine and anhydrous acetic acid is added a quantity of 14 grms. of pure octylen, previously mixed with anhydrous acetic acid; acetochlorhydrine is thus formed, which, being held in solution by the acetic acid, is separated therefrom by addition of water. The acetochlorhydrine of octylen is a

highly mobile liquid, devoid of colour, of agreeable and aromatic odour, soluble in alcohol, ether, and acetic acid, insoluble in water, burns, when ignited, with a sooty greenish-bordered flame, and boils, without decomposition, at 225° C. The specific gravity of this liquid is, at 0° C., 1.026, and it consists, in 100 parts, of:—C, 58.11; H, 9.20; Cl, 17.19. Density of vapour, 7.12.

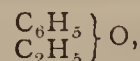
Acetic Derivatives of Mannite.—M. E. Grange.—When crystallised mannite is heated, in an open vessel, with strong acetic acid, and boiled, there is left, on cooling, a crystalline mass embedded in a syrupy liquid; the latter is separated by filtration over asbestos, and the dry solid residue washed with strong absolute alcohol, to eliminate the acetic acid. The material, thus purified, is hardly soluble in boiling alcohol, not at all in ether, and very soluble in water and acetic acid. Submitted to analysis, it yields, in 100 parts:—C, 45.42; H, 7.027; O, 47.553; corresponding to the formula C₁₄H₂₆O₁₁, equal to C₁₂H₂₃(C₂H₃O)₁₀. The author describes a series of results of experiments of various reactions of divers substances with this compound, but our space does not permit us to enter into details.

We only notice the titles of the two next papers, which are not suitable for abstraction:—

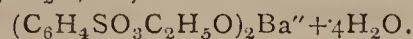
Observations on the Phenomena of Supersaturation.—M. Margueritte.

Second Notice on the Theory of Supersaturation and Solution.—M. Lecocq de Boisbaudran.

Salts of Phenetolsulphuric Acid.—MM. Opt and Lippmann.—Phenetol—



is a liquid, boiling at 168° C. When sulphuric acid is added to it, a pink colour ensues, and, after the mixture has been heated upon a water-bath for about an hour and a half, a crystalline mass is formed; this is dissolved in much water, treated with baryta water, and the excess thereof eliminated with carbonic acid. In this manner, a beautifully crystallising baryta salt of the phenetolsulphuric acid is obtained; the composition of this salt, in 100 parts, is:—C, 35.62; H, 3.03; Ba, 25.04; H₂O, 11.78. The formula is—



The authors briefly describe the lead and potassium salts of this acid.

Elimination of the Nitrogen contained in Beet-Roots during the Process of Manufacturing Sugar therefrom.—M. A. Renard. This paper is chiefly of importance to beet-root sugar makers.

On the Meteoric Stone Fallen from the Sky, on the 22nd of May, 1869, at Cléguérec, Département du Morbihan, France.—M. Limur states that, on the evening of the 22nd of May last, at 9.45 p.m. local time, there was heard at Vannes, the capital town of the department, a heavy report, like that due to the firing of large ordnance, while the sky was at the same time illuminated by a bluish white light, accompanied by sparks somewhat like those of fireworks. The next day the author learned that, at Cléguérec, a meteoric stone had fallen, which had been broken into pieces by the peasantry, and fragments of which, weighing 22 and 16 kilos, had been secured by some parties, who, knowing the value scientific men attach to these extra-terrestrial visitors, will shortly send them to Paris for investigation.

Palladium and Hydrogen.—M. Favre states that, according to his experiments, the hydrogen in palladium saturated therewith is present as a chemical compound, and not simply in the state of condensed gas. The author also states that the vapour of boiling mercury is as little a conductor of electricity as hydrogen is, and that, therefore, the non-conductibility of hydrogen for electricity cannot be regarded as an objection to its being a metal.

Cosmos, No. 23, June 5, 1869.

The only communication contained in this number suitable for translation to our pages is—

New Marking Ink for Linen.—M. Kuhr recommends the following preparation:—One part of hypophosphite of soda, and two parts of gum arabic are dissolved in sixteen parts of distilled water. The tissue, linen, or cotton to be marked is thoroughly moistened with this liquid, and then left to dry. After having become well dried, the following liquid, composed of one part of nitrate of silver, and six parts of gum dissolved in six parts of distilled water, is used as marking ink, with a quill pen. The mixtures here described are stated to yield an indelible, and very deep black-coloured ink.

Bleaching Soap.—This is a soda soap prepared according to the excellent prescription of the Prussian Pharmacopœia, which prescription has been copied in almost all other works of the kind; the soap is separated by common salt, and after this one-fourth of its weight of sulphite of soda is added, which has been previously made into a homogeneous paste by means of a little water; the soap is next dried in the usual manner. In order to apply this soap, chiefly intended for the bleaching of straw hats, but perfectly fit for application to silk and wool, it is dissolved in its own weight of cold water, and to every 2 lbs. of soap, ½ oz. of liquid ammonia is added. As soon as the mass has assumed a gelatinous aspect, 1 part thereof is dissolved in 8 parts of warm water. The materials which it is desired to bleach are washed and scrubbed by means of a brush in this soap-sud; while yet moist, the materials are placed in acidulated water (25 parts of water and 1½ of hydrochloric acid), left in this liquid for 2 hours, and then well washed, and rinsed with pure cold water, and dried. This soap is very largely and successfully used in Russia, and was first prepared in that country by Dr. Werner.—*Pharm. Zeitschr. f. Russl.*

PATENTS.

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1243. A. Borgnet, Swansea, Glamorganshire, "An improved composition to be employed as a paint."—Petition recorded April 22, 1869.

1539. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved process for obtaining gelatine and other products from animal substances."—A communication from D. K. Tuttle, O. Lugo, W. J. Hooper, and T. Hooper, Baltimore, Ma., U.S.A.—May 19, 1869.

1575. C. W. Siemens, Great George Street, Westminster, Middlesex, "Improvements in calcining and smelting ores, and in furnaces and apparatus employed in connection therewith, which furnaces are also applicable to other purposes."—May 21, 1869.

1582. H. R. Lumley, St. John's Wood, London, "Improvements in treating and purifying crude iron, and in making steel, and in an apparatus for such purpose."—May 22, 1869.

NOTICES TO PROCEED.

106. C. P. Coles, Mountfield, Bonchurch, Isle of Wight, "Improved means of protecting the bottoms of ships, or other submerged structures, from fouling."—Petition recorded January 13, 1869.

130. P. Spence, Newton Heath, Manchester, "Improvements in the production of sulphate of potash for the manufacture of alum."—January 15, 1869.

148. F. Braby, Camberwell, Surrey, "Improvements in the commercial manufacture of sulphate of ammonia."—January 16, 1869.

186. H. A. Bonneville, Paris, "Improvements in the manufacture of illuminating gas, and of sponge, by the action of hydrocarbon liquids, or fluids, on metallic ores, and in the furnaces for melting said sponge and other metals."—A communication from C. J. Caumon, Toulouse, France.—Petition recorded January 20, 1869.

223. W. M. Welling, New York, U.S.A., "Improvements in compositions resembling ivory."—January 25, 1869.

246. C. Gil, Boulevard des Capucines, Paris, "Improvements in the manufacture of sugar."—January 26, 1869.

252. T. Vaughan, Middlesborough-on-Tees, Yorkshire, and J. W. Smith, Manchester, "Improvements in treating smoke and soot for the preparation of an article of commerce therefrom."—January 27, 1869.

262. A. C. Pass, Bedminster, Bristol, "Improvements in the method of, and apparatus for, condensing and purifying metallic and other fumes, vapours, gases, and smoke, and in obtaining oxide of zinc."—January 27, 1869.

287. F. Jay, South Lambeth Road, London, "Improvement in the manufacture of oil paint."—January 29, 1869.

330. C. D. Abel, Southampton Buildings, Chancery Lane, "The production of a new or improved hydraulic cement or artificial stone."—A communication from J. A. Dubus, Rue Aubert St. Denis, near Paris.—February 3, 1869.

355. F. Braby, Camberwell, Surrey, "Improvements in the treatment and utilisation of the waste solution of sulphate of iron, resulting from the cleansing of iron surfaces in the process of galvanising."—February 5, 1869.

376. E. Meldrum, Dechmont, Linlithgow, N.B., "Improvements in the manufacture of paraffin oil."—February 6, 1869.

753. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the preparation of artificial fuel, and in the manufacture of gas and coke therefrom."—A communication from J. M. J. C. Du Lin and J. A. C. d'Almas, Paris.—March 11, 1869.

1260. J. Major and W. Wright, Swallow Street, Middlesex, and G. H. Jones, Alpha Road, Middlesex, "A new or improved manufacture of white lead, and apparatus employed therein."—April 24, 1869.

1409. F. C. Knowles, Lovell Hill, Berks, "A new or improved method of purifying and converting cast-iron into malleable iron, or into steel, and for the making and use of materials and appliances for the same."—May 8, 1869.

1426. W. E. Newton, Chancery Lane, "An improved process and composition for hardening common or grey cast-iron, and for converting articles of iron into steel, or imparting thereto a steely character."—A communication from B. W. Nichols, Canton, Ohio, U.S.A.—May 10, 1869.

1431. H. Bessemer, Cannon Street, London, "Improvements in the manufacture of malleable iron and steel, and in furnaces and apparatus employed for their fusion and treatment."

1432. H. Bessemer, Cannon Street, London, "Improvements in the construction and mode of working furnaces and apparatus employed in fusing malleable or wrought-iron and steel, and pig or other earburets of iron, and obtaining cast-steel, or homogeneous malleable iron therefrom."

1433. H. Bessemer, Cannon Street, London, "Improvements in the conversion of fluid crude iron, and molten pig or other carburets of iron, into fluid homogeneous malleable iron and steel, whether such pig or other crude iron is used alone, or is mixed with a portion of malleable, or more or less decarburised iron, in a solid or fluid state."

1434. H. Bessemer, Cannon Street, London, "Improvements in the treatment of crude, or pig-iron, and other carburets of iron, and in the apparatus employed for such purposes."

1435. H. Bessemer, Cannon Street, London, "Improvements in the construction and mode of working blast furnaces employed for smelting the ores of iron, and in the mode of employing and utilising the gaseous products of such furnaces, and also in the construction and mode of working blast engines employed to force air into blast and other furnaces."—May 10, 1869.

1582. H. R. Lumley, St. John's Wood, London, "Improvements in heating and purifying crude iron, and in making steel, and in an apparatus for such purpose."—May 22, 1869.

NOTES AND QUERIES.

Pierates.—"T. E. D." is referred to either Watts's "Dictionary of Chemistry, the *Handwörterbuch der Reinen und Angewandten Chemie*, vol. vi., or any treatise on chemistry, wherein he will find the required information, too long for the space at our disposal in Notes and Queries.

Reeovered Grease.—We do not quite understand the meaning; for, as long as grease is not saponified, or otherwise altered, or purposely adulterated, so as to become thereby unfit for use, it remains grease to all intents and purposes, and its physical and chemical properties remain then, of course, unaltered.

Scale of Temperatures.—The latest edition of Gehler's extensive *Physikalisches Lexicon*; also the works of Karmarsch, and Precht's *Technologische Encyclopedie*, contain what is desired by our correspondent, who will find these works either in the library of the British Museum, or that of the Commissioners of Patents.

Ineradicable Writing.—A French technical paper, specially devoted to the art and science of paper manufacture, states that any alterations or falsifications of writings in ordinary ink may be rendered impossible by passing the paper upon which it is intended to write through a solution of 1 milligram (0.01543 English grain) of gallic acid in as much pure distilled water as will fill to a moderate depth an ordinary soup-plate. After the paper thus prepared has become thoroughly dry, it may be used as ordinary paper for writing, but any attempt made to alter, falsify, or change anything written thereon, will be left perfectly visible, and may thus be readily detected.

New Sulpho-Salts.—Can any one explain the notation and formulæ of Schneider's new sulpho-salts? If the new notation be intended, the nearest approach would be, in old terms,—

	Schneider.	
$KS + Fe_2S_3 =$	K 19.6	24.59
	Fe 37.6	35.19
	S 42.8	40.22
	100.0	100.00

But the bismuth salt is much more discrepant.—CHEMICUS.

["Chemicus" is reminded that all formulæ and all cyphers are correctly reproduced from the original papers they are taken from; and that the authors, and not we, are responsible for the formulæ, &c., which we have no right to alter or change.—Ed. C. N.]

"On Employment of Constant Factors in Calculation of Indirect Analysis."—The following appears to me to be a more simple and more easily recollected method for determinations by indirect analysis:—Presuming the salt is ascertained to be a mixture of the chlorides of potassium and sodium, and the amount of chlorine has been determined, calculate the weight of NaCl corresponding to the weight of chlorine found; then, since for every molecule of NaCl that is replaced by KCl there will be an increase of weight equal to 13 (i.e., the difference between K and Na), the difference between the calculated weight of NaCl and the weight of the salt, being due to the extra weight of K over Na, will, if divided by 13, give the number of atoms of Na which are replaced by 12 in the mixture; and the number of atoms, multiplied by the atomic weight 39, will give the weight of potassium, which, together with the weight of chlorine, being deducted from weight of salt, will give the weight of sodium. A general formula may also readily be used for determination of any substance formed by three elements—

Let (a) be the combining equivalent of the heavier element;
Let (b) be the combining equivalent of the lighter element;
Let (c) be the combining equivalent of the determined element.

$$(a^m + b^n + c^m + n)$$

will then be the formula for any such compound; let it be equal to (x), calculate—

$$(b^m + n + c^m + n);$$

let it equal (y); then—

$$\frac{x-y}{a-b} \times a$$

will give the weight of (a) contained in the substance.—M. P.

MEETINGS FOR THE WEEK.

WEDNESDAY, 23rd.—Geological, 8.

THURSDAY, 24th.—Zoological 8.30.

Royal Society Club, Anniversary, 6.30.

THE CHEMICAL NEWS.

VOL. XIX. No. 499.

THE FARADAY MEMORIAL.

THE Faraday Lectureship has been worthily inaugurated. M. Dumas, representing not alone the chemists of France but the chemists of Europe, has given us a lucid and comprehensive discourse, in which he has surveyed, from our present stand-point, the position of chemistry and its relations with past science, and has, moreover, pronounced an admirable *éloge* of him whom the discourse commemorates. No one could be more eminently fitted than M. Dumas to undertake this duty: he was the intimate friend of Faraday, and with him he somewhat connects the chemistry of the past with the chemistry of our day; he stands pre-eminent among the chemists of his country, and has had much influence upon the entire *cultus* of France during the last quarter of a century. And what are his relations with the past? He was born a few years after the death of Lavoisier; at the time when he entered the chemical world the system of Lavoisier was firmly established, was universally accepted. He may have seen as a boy the death of Phlogiston—that slow, long-drawn-out death, not with gasping and a discoloured visage, not with a strong clinging to life and mortal strugglings; it was rather the death of the aged and worn-out, almost a euthanasia. Phlogiston died as an old king, once infinitely dominant, somewhat tyrannical, not always just; now deposed, decrepit, utterly senile, forsaken by all, and ever harping upon his former glories. It was Lavoisier who founded the new dynasty, of which ours is as much a continuation as was the dynasty of Elizabeth of that of Henry VII. The times have changed, the *modus* of thought has changed, characteristic developments have assumed new features, and appeared with altered and contingent phases; but the basis is the same—it is firm and immutable as to its facts; and all philosophy, of what kind soever it be, all science, all social actions, are alone stable when they are founded upon the immutability of fact. We were glad to notice that M. Dumas made much mention of Lavoisier in his discourse; but not glad to observe that, while the names of Davy and Dalton were received with applause, that of Lavoisier was passed in silence. This is ungenerous and illiberal. We need not go quite so far as M. Wurtz, in his recent “History of Chemical Theory,” but let us at least acknowledge to the full that which Lavoisier has done for chemistry. In

neglecting him, we not only act unjustly, but we injure ourselves; for, did not Lavoisier confess himself the pupil of Black? And, as to the arrogance attributed to him in regard to the name of his chemistry, it seems to be forgotten that Fourcroy introduced the term *La Chimie Française*; it was a just term, and, till lately, no one has complained of it. Does not Davy speak of the “new French chemistry?” Let us forget these petty jealousies. The very institution of the Faraday lectures will, by establishing cordial unions between scientific men of foreign countries and those of our own, help to dissipate these feelings, and to produce a more complete *entente cordiale*. Meanwhile, let us express for Lavoisier, in the words of M. Dumas (in his admirable “*Leçons sur la Philosophie Chimique*”), “notre profonde admiration pour son génie, et notre douleur éternelle pour sa mort prématurée.” And let us express, for M. Dumas himself, the first of these sentiments, and thank him for having come among us: this man, who was a great chemist before many of us were born; who, more than forty years ago, wrote a many-volumed work on chemistry, which has been the text-book of a generation or so of young chemists; and who has ever furthered and adorned our science.

A word or two, about the medal which accompanies the Faraday lectureship. Of the design, and the legend which accompanies it, we fear we cannot speak in great praise, and therefore shall not speak at all; but some may be interested in knowing that the medal is to be struck in palladium, and that a quantity of this rare metal, sufficient for the medals of at least ten years to come, has just been presented to the Chemical Society by an eminent metallurgical firm. And, *à propos* of this, we may mention that M. Dumas carries back to France with him, in addition to the Faraday medal, a medal of the alloy of palladium and hydrogenium to commemorate the discovery of the latter by the Master of the Mint.

It is a matter of much satisfaction to know that at length steps have been taken to provide a memorial to Faraday in another form. While the lectureship and medal are the special memorial of the Chemical Society, this is to be the memorial of the country at large, and it is proposed that it should take the form of a statue. That the Government have held aloof from taking any part in this memorial is much to be regretted, but the Chancellor of the Exchequer has stated that he is only following precedent in not allowing public monies to be expended on a memorial to a “private citizen.” But was Faraday a *private citizen*? In one very limited sense, indeed, he was, but, in point of fact, he was a cosmopolitan. “Faraday,” said M. Dumas, “*n'appartient pas seul à l'Angleterre*,

il appartient à tout le monde." A private citizen! Who has worked more for the public good? Who has more promoted works for the weal of his country, for the welfare of his race? We hope that not only the scientific men of this country will promote the Faraday memorial, but that the whole country will subscribe to it, and that we may have not alone a statue to this great man, not alone the lectureship and medal, but some greater work, and we would suggest, as we have before done, that it should take the form of a Public Laboratory, which would afford to those who have longings for science, but who lack opportunity, a means of satisfying the yearnings of their genius. To those who "fall gloriously fighting" in the service of their country,—to those who in the Senate have promoted large interests, successful negotiations, an honourable peace, or a triumphant war,—the country and the Government never fail to raise memorials, and to give honour: let them honour him who, working quietly, and steadily, and firmly, has added so much to the internal wealth of this country, so much to the scientific literature of the world. Faraday ever held in his hand "Lampas investigationis, non torris contradictionis," and the bright steadfast light illumines all that he did, and enveloped him as he passed untimely from our sight.

ON THE

ATOMIC WEIGHTS OF GOLD, PLATINUM, IRIIDIUM, OSMIUM, RHODIUM, AND PALLADIUM.

By W. M. WATTS, D.Sc., F.C.S.

THE atomic weight of gold was determined by Berzelius from the analysis of its double chloride with potassium. He obtained, as mean result, the number 196.67, which was calculated from the weight of potassium chloride left, assuming its atomic weight = 74.57. My pupil, Mr. R. A. Jones, has pointed out that, since Berzelius determined in each case not only the potassium chloride left, but also the metallic gold set free, we have data for calculating both the atomic weight of gold and also that of potassium; so that, by comparing the atomic weight of potassium calculated from Berzelius's numbers with that given by the marvellously accurate researches of Stas, we are able to estimate the degree of accuracy of Berzelius's results. Berzelius obtained (*Lehrbuch der Chemie*, iii., 1212), in four experiments, the following results:—

AuKCl ₄ . Grs.	KCl. Grs.	Au. Grs.
(1). 4.14450	gave 0.81850	and 2.15900
(2). 2.24950	„ 0.44425	„ 1.17200
(3). 3.41300	„ 0.67400	„ 1.77725
(4). 4.19975	„ 0.82950	„ 2.18800

Calculating from Stas's number for chlorine, viz., 35.457, we obtain the following atomic weights for potassium and gold:—

No. of Experiment.	Atomic weight of Potassium.	Atomic Weight of Gold.
1	39.149	196.79
2	39.166	196.87
3	39.088	196.57
4	39.176	196.86

If we select experiments 3 and 4 as the best, and take the mean, we have K = 39.132, and Au = 196.71.

The extremely close agreement of the numbers for potassium with that given by Stas, viz., 39.133, can be considered as little less than marvellous, and may, I think, be regarded as investing the atomic weight of gold with authority scarcely less than could be obtained by a repetition of the determinations, with all the minute precautions which Stas employed in his experiments.

It must not be forgotten, however, that in this way we check only the accuracy of manipulation, but obtain no evidence of any error arising from impurity of the metal employed.

I have applied the same criticism to the results obtained in precisely the same way for platinum, iridium, osmium, rhodium, and palladium, none of which, however, exhibit the accuracy of the gold determinations; and the best result is probably obtained by calculating from the atomic weight of potassium chloride instead of from chlorine alone.

The results are subjoined—

	Calculated from Cl = 35.457.	Calculated from KCl = 74.59.	Authority.
Platinum	K = 39.35 Pt. = 197.75	Pt. = 197.18	Berzelius
Iridium	K = 39.39 Ir. = 197.54	Ir. = 196.87	„
„	K = 39.87 Ir. = 198.56	—	Claus
„	K = 39.93 Ir. = 196.62	—	„
Osmium	K = 39.28 Os. = 199.42	Os. = 199.03	Berzelius
Rhodium	K = 39.12 Rh. = 104.21	—	„
„	K = 39.89 Rh. = 104.76	—	„
Palladium	K = 39.62 Pd. = 107.19	Pd. = 106.57	„

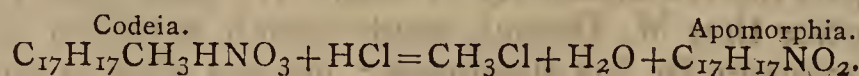
Manchester Free Grammar School,
June 18th, 1869.

ON THE

ACTION OF HYDROCHLORIC ACID ON CODEIA.*

By AUGUSTUS MATTHIESSEN, F.R.S.,
Lecturer on Chemistry in St. Bartholomew's Hospital,
and C. R. A. WRIGHT, B.Sc.

CODEIA was sealed up with from twelve to twenty times its weight of strong hydrochloric acid, and heated to about 140° for two or three hours. After cooling, a layer of colourless liquid was observed floating on the top of the brown tarry contents. It immediately became gaseous on opening the tubes, and was presumed to be chloride of methyl, as the issuing gases were found to be free from carbonic acid. The residue in the tubes, when dissolved in water and precipitated by carbonate of sodium, yielded, on extraction with ether and agitation with hydrochloric acid, a crystalline chloride, having when purified by recrystallisation, all the properties of the chloride of apomorphia derived from morphia. It gave the same qualitative reactions, produced the same remarkable physiological effects, and yielded numbers on combustion with chromate of lead and oxygen agreeing with the formula C₁₇H₁₇NO₂HCl. Hence the reaction which takes place is in accordance with the formula—



Manufacture of Sugar.—The *Journal des Fabricants de Sucre* states that experiments are now in progress in some French colonies to try, on the large scale, Messrs. Rousseau and Bonnaterre's plan of converting the saccharine juice of cane or beet-root into a peculiar saccharate of lime, and to transport that salt, instead of raw sugar, for the purpose of refining. It is said that this compound is as hard as sand, and can be transported without the risk of damage and injury sugar is subject to, and be kept for any length of time.

* Abstract of a paper read before the Royal Society, June 10th, 1869.

CONTRIBUTIONS TO ANALYTICAL
CHEMISTRY.*

By DR. E. FLEISCHER, of Dresden.

NORMAL LIQUIDS FOR VOLUMETRIC ANALYSIS.

IN the greater number of analytical examinations of free acids and alkalies, the rule is to employ a normal acid, and a normal solution of caustic potash, and also a ten-fold dilution of them (1-10th of the normal liquids). In choosing the most appropriate acid for this purpose, it must be taken into consideration that it should form with alkalies or alkaline earths only soluble salts, in order that certainty in discerning the change of colour in the liquid under examination—which is coloured with litmus—may not be injured by precipitates, and also that the carbonates of the alkaline earths may be perfectly transformed by the normal acid. On this account, nitric acid is much more useful as a normal liquid than sulphuric or oxalic acid; but hydrochloric acid is quite as appropriate as a standard solution as nitric acid, and more so, inasmuch as it is more easily obtained pure, and is more constant to one standard, while nitric acid is generally more or less contaminated by nitrous acid. Another advantage possessed by hydrochloric acid is, that the acid contained in it may be not only estimated alkalimetrically, but also quickly and exactly by a standard silver solution, a trial which is impossible in the case of nitric acid.

With regard to volatility, it is to be mentioned that hydrochloric acid, diluted to one-fifth of the normal strength, when heated for ten minutes, whilst replacing the evaporating water, will not impart the slightest tinge of red to a blue litmus paper held in the vapours evolved, and, as in alkalimetric investigations the dilution is much greater, there need not be any fear of ever driving off the free acids by digestion. Moreover, since the constancy of normal hydrochloric acid is so great that, after keeping for months, the slightest change can scarcely be perceived, provided it has been preserved in bottles well closed with glass stoppers, no impediment exists in this respect to its employment as a standard liquid.

It is well known that many chemists besides myself have performed these experiments successfully with normal hydrochloric acid, and that, in all alkalimetric determinations, they already use it instead of normal sulphuric or oxalic acid; it is hoped, therefore, that these remarks will suffice to demonstrate the utility of this testing liquid.

The second important normal solution for analysis by saturation is normal caustic potash or soda. These caustic liquids should be completely and absolutely free from carbonic acid, and, in order to prevent them from absorbing this gas from the air, a mixture of Glauber's salt and caustic lime is employed. This is contained in a tube fastened into the stopper of the bottle which contains the alkali; but this precaution does not always suffice to retain the solution of caustic alkali perfectly free from carbonic acid, for it almost always happens that an addition of a solution of chloride of barium to it produces a precipitation of carbonate of baryta in greater or smaller proportion. The preservation of caustic alkali by this means is also inconvenient, as, on account of the syphon in the bottle, it requires to be placed over the working bench, and can, therefore, only be protected from the dust by a special cover. To these drawbacks may, perhaps, be ascribed, in technical laboratories, the frequent substitution of the more easily preserved, though less appropriate, solutions of carbonate of potash or soda for the caustic alkaline solution as a normal standard liquid.

All these inconveniencies, which exert more or less influence upon the exactitude of estimation, may, however be remedied by employing, instead of the normal potash or soda solution, caustic ammonia of half the normal strength. Of all caustic solutions, caustic ammonia dis-

plays the most complete indifference to carbonic acid; so complete, in fact, that a flask half filled with half-normal ammonia, well closed with a glass stopper, and which was frequently opened for estimations to be made, gave such slight indications of carbonic acid after three months' preservation, that, upon half filling a large test-glass with it, and adding some drops of concentrated acetate of lime, no perceptible turbidity ensued, even on heating; whereas two bubbles of carbonic acid gas introduced into it from a gasometer instantly produced a considerable deposit. Moreover, the standard of this half-normal liquid was so slightly altered during the three months, that 1-10th c.c. of a tested normal muriatic acid was scarcely less saturated by 50 c.c. of it, than would have been necessary by an exact standard.

It follows from these experiments that the half-normal ammonia liquid is at least as useful in acidimetric work as the best caustic potash solution; besides which, the former has the advantage of being conveniently preserved, and of being easily obtainable chemically pure.

With respect to the importance of the appearance of a blue colouration of the litmus by a liquid reddened by free acid, so as to fix the final reaction in analysis by saturation, the following is worthy of remark:—

Cold diluted (to at least 1:10) solutions of neutral sulphate or nitrate of ammonia scarcely produce any perceptible change in blue litmus paper—at any rate, much less than that produced by the introduction of two bubbles of carbonic acid. Sal-ammoniac reacts, under these circumstances, as neutrally as chemically-pure chloride of potassium, or chloride of soda; and a single drop of half-normal ammonia produces in such litmus-coloured solutions a strong and lasting blue colour, slightly inclining towards violet.

Hot solutions of the ammoniacal salts in question, and especially sulphate of ammonia, act upon litmus in a somewhat acid manner, about the same as free carbonic acid; hence it follows that, in all estimations by ammonia, the liquid to be tested should be cold. Should it have been previously heated, it is advisable that it should be cooled as much as possible by first exposing it for some minutes to the air, and then setting it in cold water. If this be attended to, the distinctness of the tint will leave nothing to be desired. The objection may be raised, that ammonia cannot be employed, like potash or soda, as a normal, but only as a half-normal, liquid; the relation of the base to the acid as 2:1 is, however, more advantageous to the exactness of the determination than if both fluids possessed the same equivalents.

As all volumetric estimations, excepting those of such caustic liquids as caustic soda, potash, baryta, and ammonia, are finished by re-estimating the acid with ammonia, and, as 1 c.c. of normal muriatic acid corresponds with 2 c.c. of half-normal ammonia, the re-estimation is much more exact than if solutions were used containing equal equivalents. The usual 1-10th normal solutions may also hereby be dispensed with in almost all cases, if the experiments be carefully carried out. These remarks will demonstrate that I can specially recommend the employment of half-normal ammonia and of normal muriatic acid as standard liquids for analysis by saturation; at the same time, I may observe that, for testing acids combined with metallic salts, I employ normal potash, supersaturating with a measured quantity of muriatic acid the free potash present in an aliquot part of the filtrate, calculating the combined acid after removing the carbonic acid by heat, and re-estimating with ammonia.

The standard of the normal muriatic acid is ascertained by a weighed amount of pure carbonate of lime, slightly heated. The best way to preserve both liquids is in well-closed flasks, with glass stoppers. They should be placed in a cool place, free from dust. In hot summer weather, the flask containing the half-normal ammonia should be placed in cold water, which should be renewed daily, because a continued temperature of 25° C. will alter its standard, though only in a slight degree.

* Communicated by the Author.

ON THE
EXAMINATION OF WATER FOR ORGANIC
MATTER.*

By R. ANGUS SMITH, Ph.D., F.R.S., &c.

(Continued from page 282.)

LET us now consider what does take place during putrefaction. In all cases known to me, the first thing that occurs is the diminution of oxygen in the air absorbed by the water, and, to a more or less extent, the production of sulphuretted hydrogen, which, however, may exist in the water to a very small extent at a time, being rapidly converted into combined sulphuric acid when oxygen can be found for the purpose.

In Loch-Katrine water, the oxygen found in the absorbed air, by Dr. Penny, was equal to 31.69 per cent; that of the Manchester water is equal to 27 per cent. In the Liverpool water, at the bottom of the reservoir, the amount fell to 12 per cent, being equal on the surface to the Manchester. In the first case, as well as in the second and similar cases, the amount of oxygen is too great to allow of putrefaction; and in the third case it was very clear that the oxidation was a process of decolourisation, at least in part, whatever else may have occurred. This decolourisation is caused by the oxidation of the *humus* and its removal as carbonic or other acid.

The gases of pure water contain nearly 34 per cent. of oxygen.

Dalton found cistern-water almost entirely deprived of its oxygen; and I have found every percentage of oxygen from 34 downwards.

I go further into this point in my chapters on water, which I hope to bring out soon. Meantime I may say that the examination for oxygen is a very important one.

Another important feature in putrefaction is the occurrence of carburetted hydrogen. The carbonaceous or organic compound, having lost the ties that bound it together, is broken up into fragments. The carbon, when it can find oxygen, goes off in its company, but otherwise it leaves with hydrogen; separate, however, it must, and that with considerable violence. When there is a great amount of oxygen these decompositions of organic matter do not take place; and even if the Loch-Katrine and other water were largely supplied with organic matter, putrefaction would be entirely absent, as it now is, as long as the high amount of oxygen was kept up in continual presence.

That organic matter does exist in peaty water to a larger extent than in streams not peaty, but still offensive, may be taken for granted. A very brown water contains about four grains per gallon. It is extremely dark, indeed, if there are six grains; but, without peat, putrefaction, or, what is still worse, the development of mischievous germs, may occur, whilst in the other they seem stifled. How far this disinfecting and preserving quality of peaty matter will act in weak solutions I cannot tell; but in its greatest strength (that is, surrounded by the matter of the peat itself), preservation may exist for an indefinite time; and the non-occurrence of putrefaction in weaker solutions may be considered sufficient to show that there is abundant antiseptic power for the amount of matter to be preserved in these waters.

But the question still arises, what is this organic matter containing nitrogen? If it is albumen it is disinfected, if the peat is great in amount; and it is incapable of putrefaction, if the oxygen is great.

We are not perfectly sure that these ammoniacal humates of Mulder's actually exist in the form he mentions. It may be that the nitrogen is otherwise combined, giving another mode of explaining the conditions of the water.

If they are combined, as Mulder believes, we have only to allow oxygen to enter the brown water and be absorbed, a process which readily occurs; the *humus* is bleached, and the ammonia is free to combine with carbonic acid, and readily to dissolve a fresh portion of the same salts of which it formed a part. If the nitrogen be otherwise combined, whether as albumen or any similar substance, the oxygen would still play a corresponding part.

By this view of the subject, the brown waters would be giving off carbonic acid, freeing and losing some carbonate of ammonia. When oxidation takes place, a certain acidity is found, coupled with a little bitterness, a quality possessed by great portions of the waters of the hills. This, I believe, occurs in those waters which have not been purified by descending deep into the earth (where thorough oxidation and sweetening take place), but which have passed only over the surface, and been partially oxidised. The complete oxidation produces carbonic acid; the restricted oxidation an acid that is not volatile, and is extremely bitter. I have prepared so little of this, that I am unable to give a good account of it. It was formed from extremely brown water, chiefly from the river Avon, in Lanarkshire. By its formation, the water became very bright; when boiled down, the acid became stronger to ordinary tests, and its bitterness became more intense.

I may remark, by the way, that in all the bottles in which this occurred there was a deposit of very fine flakes of silica, leading me to think that, by our usual modes of estimating that substance, we were apt to make the amount too small. I believe this acid to be the origin of that bitterness which I have so often observed on the hills; and even in the very brilliant water from the hills, the two processes have been going on at the same time—the formation of carbonic acid and the formation of the non-volatile acid.

Apparently there are times, perhaps flood-times, when the water does not become oxidised so much as usual; and then we find the bitterness as a result in a greater degree. Although I had observed this for many years, I had not known that the effects might be hurtful to those who drank the waters. I met this year, accidentally, at Oban, Professor Frankland, who told me of some gentlemen who had been very much inconvenienced and who actually took supplies of spring water with them to Inverness, at which place they had found the river to cause diarrhoea. I am not aware that this disease is more frequent at Inverness than elsewhere; but the water, or at least the substance in it, to which I allude, seems to be unwholesome to those who have not been accustomed to use it.

Chloride of calcium is observable in water from the clay slates of the west of Scotland, at least in some places. It is found also in Loch-Katrine water, although I have not seen it mentioned.

For some years I was inclined to believe that the bitter taste was owing to these salts, until I found it increased by oxidation. I am not prepared, however, to say that they are incapable of modifying the taste, although they exist in quantities very minute.

Taking this view of the case, water collected in the mountains is very different from that which has run down into the plains. The age of the water also is a matter of importance, and if kept long in deep reservoirs or in shallow reservoirs.

If in shallow reservoirs, the water may be uniform throughout; if in deep reservoirs, the oxygen may never be able to permeate to the bottom. At a depth of twenty feet I have found more than twice as much organic matter than was to be found on the surface, whilst the lower specimen was of a much deeper brown. This was in the Rivington reservoirs, as already said.

Water that comes down very rapidly may never be able, in a practical period, to have the organic matter thoroughly

* From vol. iv., 3rd series, of the *Memoirs of the Literary and Philosophical Society of Manchester*. (Communicated, with emendations and alterations, by the author.)

oxidised. Water which purls down rather slowly, falling, nevertheless, over many rocks, is always clearer, although the reason partly of this is, that such water is not surface only, but has drained through the soil.

Peat itself, if distilled with fixed alkalies, gives out ammonia. I suppose there is no doubt that some of this arises from the decay of vegetable albumen, some of which may be retained in the peat; but its mode of decomposition is still a problem; it seems to take place chiefly by oxidation, not putrefaction. I was inclined to think that a notable amount of the ammonia might be taken by the acid waters direct from the atmosphere.

But the smoke of peat, or rather the oily matter deposited by the smoke, contains nitrogen compounds, very probably the bases obtained by the decomposition of that vegetable albumen, which will not enter into fermentation, or expand itself into the lower and dreaded organised forms, although compelled to yield to the action of fire. This shows that all the nitrogen does not exist as ammonia. Although Mulder is highly to be honoured for the work performed in endeavouring to elucidate the subject, and especially the question relating to *humus*, it is not easy to agree with him. If, however, any one would begin where he has left uncertainty some reward would be found.

I give a few quotations from Mulder's "Physiological Chemistry," first German edition:—

"I repeat that the ammonia in the soil, as in the natural saltpetre-grottos of Ceylon, is formed from the atmospheric air, the oxygen of which, instead of forming nitric acid, changes the organic substances into ulmic acid, then into humic acid, geic acid, apocrenic acid, and into crenic acid.

P. 158. "This formation of ammonia from the constituents of the air and water is of the highest importance for the growth and success of the plant. It is the cause which converts the insoluble organic constituents of the soil into soluble substances, and thus presents them to plants as organic food, even when no ammoniacal manures are added besides to convert the five mentioned acids into soluble salts of ammonia."

P. 166. "Ulmic, humic, and geic acids, however formed, possess the power of absorbing ammonia and water to the extent of several per cent. The quantity given out (at 140° C.) is between 8 and 16 per cent. It requires 195° to free them from water."

P. 167. "The power of ulmic, humic, and geic acids to condense ammonia is so strong, that the acid made by acting on sugar with hydrochloric acid almost always contains ammonia if air is not kept away."

P. 169. "These acids combine so intimately with ammonia, that they have the character of an organic compound of four elements; by treatment with potash at a higher temperature they lose the ammonia completely."

In the "Handwörterbuch der Chemie," under "Humus," it is said that by constant digestion with hydrochloric acid, ammonia was not removed. It is also added that, boiled with an alkali, the ammonia is not removed.

This accounts for the opinion held by Berzelius and others, that nitrogen existed in these earth acids; and certainly it is not clearly shown that they are only ammoniacal salts.

Berzelius gives Hermann's old analysis of crenic acid as containing nitrogen; and until we can finally settle the composition of these substances, we may be allowed to doubt. Whatever the compound be which contains nitrogen, its disinclination to putrefy must lead us to believe that even the organic nitrogen is not a measure of the dangerous quality of water, whether that nitrogen exist in a non-putrescent condition or association of the albumen, or in a substance removed a step from albumen and passing downwards to a condition more allied to the idea of an inorganic body. My own belief is that part of the ammonia is in combination with earth acids, and part of that which we find is obtained by destroying an albu-

minous substance rendered non-putrescible by its surroundings.

I have given my reasons for believing that neither the nitrogen of ammonia nor the other nitrogen found in peaty water can be taken as the indication of the amount of putrescible matter. At present, I believe, we have no idea of the actual relation in which it stands to health. It will be interesting to know now if the nitrogen of the nitrates and nitrites is at all similar. These salts are not formed when putrefaction is going on rapidly. The reason is very simple: the water is then deprived of its oxygen. We do not know all the conditions of the formation of these salts; but one is essential, that oxygen shall be present.

In the Thames water, at least two miles below and above Hungerford, there was nitric acid in considerable abundance in 1848. It is mentioned, in evidence given in a parliamentary inquiry twenty years before that, that red fumes rose on heating the deposit. I quote from memory.

In 1848 this was certainly the case. In later analyses, by Dr. Hofmann, the nitric acid was not mentioned. I considered this at the time a mistake; and I examined the water again, finding, however, extremely little nitric acid, and, I believe, in some cases none.

Having examined other putrid streams, and found no nitric acid, I conclude that it had disappeared from the Thames also when it became more impure than previously.

During the time that river was so offensive near the Houses of Parliament, the organic matter must have wholly, or nearly deprived of its oxygen the air in solution. Running streams, however, do not, so far as I know, contain much nitric acid; that substance is formed in greatest quantity by the action of porous bodies. The oxidation is assisted by the pressure to which the gas is exposed by being brought in contact with a great amount of surface, as well as of numerous surfaces contributing to the result. For these reasons nitrates are found best in soils through which azotised matter in solution is slowly passed.

I had occasion to make experiments on this point, and showed, in a paper to the British Association, in 1848, that a filter might be made to form nitrates from putrid matter.

An interesting question arises—Does the nitric acid indicate the amount of organic matter which was previously in solution?

If nitrates are put on land, they are decomposed by vegetation, and the nitrogen is retained. These salts act both as food and air to plants. The water which flows from drained land may contain nitrates, but they are not a measure of the amount put on the land; and if they result from the organic matter there, they are still not in proportion to its amount, as, even after they are formed from vegetation, they may be decomposed by it.

Nitrogen, therefore, may be removed from water either as ammonia, or organic matter, or nitric acid, every trace of it finally disappearing. Those nitrates, however, which do remain indicate that at least an equivalent of albuminous matter or sewage matter did exist.

Another interesting question occurs—Is the nitric acid removed without vegetation? I believe that it is so.

In water from drained fields vegetation is generally found, though frequently in very small quantities. In the soil around drains it is found in considerable quantities; but after putrefaction has occurred in the Medlock, at Manchester, I have not found it. The oxygen seems to be removed as the oxygen of the air is, probably leaving nitrogen to pass off as gas.

As the nitric acid indicates an equivalent of albumen, I have put it down as telling us of the previous presence of organic matter; in other words, of old organic matter. The word "old" has no relation to time, except so far as to mean older than that from which the nitrites are formed, and the original organic matter. The nitrites,

not being fully oxidised, are supposed to be in the process of becoming nitrates. They have been taken, therefore, as indicating recent organic matter,—the word "recent" meaning only that they stand between the organic matter and the nitrates. I do not know that nitrates are converted into nitrites in water. Still it may be found to be so.

It may be asked,—If the nitrates are not a proof of albuminous matter, whence do they come? If it is said from the air, as Mulder would bring them, we need a proof; if from ancient remains, we need a proof; but we need no proof that they can come from albuminous substances. I believe they come from both animal and vegetable matter, so that decomposing roots and plants will send out some; but animal matter is the richest source. We have animal sewage and vegetable sewage. The latter is capable, as is well known, of doing much evil—perhaps not so much as the former, although this is uncertain. It does not seem proved that grass itself will not give nitrates. Yeast produces them. If vegetable and animal albumen are equally bad, we need not care as to the distinction of source; if nearly equal, we may care but little.

In looking for organic matter, I think it quite unsafe to trust either to chemistry or the microscope, without giving time for the development of all possible germs; but this is a point which demands a good deal of inquiry. Microscopists have given us details of appearances; but these have not been sufficiently classed; and the conclusions drawn have, therefore, not been valuable to the desired extent. To trust to the microscope without time for development, is to believe that the germs of disease can be seen. The use of allowing water to stand is not that the germs of disease may be seen, as we do not know them if we see them, but to see if the matter is active. The value of this must be tested.

The loss of the oxygen with peaty matter and no vegetation indicates, as already said, the formation of carbonic or a bitter acid. The loss of oxygen with the evolution of sulphuretted hydrogen indicates putrefaction; but there are two conditions which externally resemble each other very much, namely, the growth of vegetable matter with diminished oxygen, and the growth of vegetable matter with excess of oxygen. Water in the first of these conditions, too, may contain, as I imagine, the most dangerous ingredients: germs of all diseases may exist in such waters; we do not know to what extent; and, as we are very ignorant on the subject, it is well to be alarmed at the conditions, until we have examined them and made distinctions.

We do not know very much about the second of the two; and if I think it less dangerous, it is perhaps more from a prejudice in favour of the abundance of vital air, and of those hill-waters which do not contain bitter peat than from any accurate knowledge which has been attained.

Weighing the Organic Matter.

If nothing apparently organic is seen, or if there be no time to allow it to germinate, we may try the following method. About half a gallon of water is boiled down in a platinum vessel; or if there are no soluble carbonates it may be boiled in porcelain and transferred with care, when only a few ounces are left, to a platinum or even to a small porcelain capsule. The residue is dried and weighed. It is then burnt so as to oxidise the carbon, and weighed again; the difference gives the organic and volatile matter of the residue. 212° F., or 100° C., is not sufficient to remove all water; but as it is a temperature so easily obtained, it is convenient to consider it enough, especially as we cannot obtain the organic matter by weighing with absolute exactness. We may obtain an excess of water by the use of 212° , on one side; but, again, organic matter begins to be given off from some residues even at that temperature; Professor Miller and others advise about 300° F. It is, at any rate, well to state the

temperature in the account of the analysis. Both temperatures appear to me wrong, and so is every other I can think of. The results, however, of this method are very useful.

The burning must not be effected at a very high heat, or several salts will be decomposed or evaporated; but at best some will suffer; and the use of a little carbonic acid and water, or carbonate of ammonia, to restore the lost amount is advisable. A little distilled water and a few expirations into it through a glass tube will be sufficient for most cases; of course after this the ash must be heated again.

Professor Miller advises the addition of 0.3 gramme of carbonate of soda to a litre of water, or 20 to 25 grains to a gallon, making allowances in the weighing.

It is needless to remark that I consider Frankland's mode of obtaining carbon and nitrogen far superior to any weighing, when hands sufficiently delicate are found. By using larger quantities, there seems no reason for supposing that the process cannot be undertaken by men who cannot advance beyond average refinement of touch. Since this paper was read, about a year and a half ago, the Wanklyn process for nitrogen has been gaining favour in my laboratory, as the results obtained have been very constant.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Meeting held at the Royal Institution, June 17th, 1869.

Dr. A. W. WILLIAMSON, F.R.S., President, in the Chair.

The minutes of the previous meeting were read and confirmed, and the following certificates read:—

For the first time—E. A. Blackwell, Analytical and Consulting Chemist, 6, St. Sacrament Street, Montreal, Canada.

For the second time—John Morrison, Analytical Chemist, County Wicklow, Ireland; W. G. Lewis, Fellow of Oriel College, Oxford; Alfred Dudley Keightley, Gatcheck Gunpowder Mills, Old Hall, Milnthorpe, Westmoreland.

The PRESIDENT then addressed the meeting as follows:—

The Society is here assembled to inaugurate what would be inadequately described as a monument in honour of Faraday. The Faraday Lectureship has been founded by the Council of the Chemical Society in the hope that it will promote the advancement of human knowledge, and surely no higher tribute of respect could be paid to a great man than to do in his name what he would have loved best to see done. Now, among the arrangements which are made for the promotion of interchange of ideas—ideas which are so essential to those who are working in the investigation of nature—there is one particularly important defect and shortcoming. We have books and papers which circulate throughout the length and breadth of the civilised world, and in each country there are Societies where men meet together to consider and discuss questions relating to science, and to aid and encourage one another in various ways. But these books and papers give but the skeleton of a science without that life and interest which is imparted to facts when communicated by a discoverer himself. And, on the other hand, Societies, although they do much for the promotion of science, leave still more undone. It is an essential of truly philosophical work that questions be viewed from various sides; and those who have followed with any attention the recent history of our young science, must have been struck with the variety of lines of thought followed simultaneously by independent workers—lines of

thought which finally converge in certain general truths; their convergence serving to corroborate the evidence of those truths, and to establish more perfectly the conclusions which are thus arrived at. Now, the greatest difficulty which is experienced, and the greatest defect which one observes, is this, that workers in one line of thought are too frequently ignorant, or insufficiently cognizant of what others are doing; and the defect shows itself chiefly between those who are working in different countries, more than between those who are working in the same country. Now, imagine that we could induce to come among us a man possessed of one of those master minds which forms a focus of light throughout science, and amongst all those who are interested in science: suppose that he were to tell us the thoughts which are uppermost in his own mind, and—best of all—that he were to make us for a time think with him in the very words of his own language: imagine that such a highly gifted man combined in his own person the genius of a discoverer, the breadth of intellect of a philosopher, and the lucid fluency of an orator. I am sure that you would agree with me, that his visit would inaugurate something which Faraday would truly have rejoiced to see. Imagine, I say, those things: accurately fix in your mind's eye the image of such a man—and Dumas is before you! [Loud applause.]

M. Dumas, La Société vous reçoit comme le plus illustre représentant du progrès de notre science. Nous sommes heureux et fier de vous avoir parmi nous,—heureux de vous voir et de vous entendre, fier de ce que vous êtes venu au nom de Faraday. Je vous présente cette médaille qui a été frappée en commémoration de votre visite, et je vous prie de conserver avec elle le souvenir de cette réunion.

M. DUMAS's lecture* commenced with a brief *éloge* of his friend, the late Professor Faraday. The Lecturer then, with admirable eloquence, passed to the consideration, first, of what he termed "*la matière brute*," and of its forces; and, secondly, of organic matter and the forces special to it. He traced the origin of some of the more important modern chemical doctrines to the labours of the Greek philosophers, and identified the principle of the ancient classification into fire, air, earth, and water, with that of Lavoisier's chemical elements. He acknowledged his great admiration of the labours of Dalton and Prout, and in a most lucid manner pointed out relations between the atomic weights of the now received elements which led him to infer the probability of many of them having a common basis. The audience was reminded that many years ago M. Dumas had contended that organic bodies are constituted in a manner similar to mineral bodies, and he took occasion to show how the progress of chemical research had confirmed the truth of this view, he himself being disposed to limit the term "organic substance" to those very few compounds which take part in the growth of organised beings.

Professor TYNDALL then spoke as follows:—Fellows of the Chemical Society, Ladies, and Gentlemen—It becomes my duty to ask you to return your best thanks to M. Dumas for the noble discourse which you have just heard; and I sincerely thank the President of our Society for giving me this opportunity of testifying to the respect and high regard which I personally entertain for our first Faraday lecturer, both as a man and as a philosopher. [Applause.] It is now, Sir, [turning to M. Dumas] one and twenty years since, in company with the gentleman who now sits at my side, I first heard your voice. It was in your own *Collège de France*, and to this hour I have not forgotten the impression that you then made upon me with regard to your clearness, your power, and your eloquence as an expositor of scientific truth. You then, Sir, were celebrated as an investigator, and, as I thought, you were in the very blossom of your strength; but, Sir, I was wrong. You have this night shown a vigour and a

depth and a capability of grappling with great questions, such as I doubt whether you possessed in equal vigour twenty-one years ago. You have to-night, Sir, grappled with some of the weightiest questions which underlie both chemistry and physics, and which constitute, if I might be allowed the term, the very solder of the material universe; and you have, moreover, vindicated the claims of science to a higher recognition than that which may be fairly based upon the material results that flow from it. You have shown how it can connect itself with philosophy, and with the general culture of the human mind. Sir, the walls which here surround you are associated with immortal memories. For more than sixty years they have been accustomed to hear voices which have gone forth into all lands. They have heard the voice of the great Thomas Young, of Humphry Davy, and of Michael Faraday; and we, Sir, bid you welcome to the scene of their teachings and of their triumphs. [Loud applause.] We, Sir, wish with all heartiness that you may long preserve the vigour which you have here displayed to-night, employing it as you have just done, for the delight of your hearers, the honour of science, and the good of mankind. [Applause.]

Professor ODLING: I feel it a great privilege, and at the same time a great difficulty, after the eloquent remarks of Dr. Tyndall, to second the vote of thanks to M. Dumas, which he has proposed. As an old officer of the Chemical Society I may say we all felt that we could not find a more fitting or more able inaugurator of the Faraday lectureship than M. Dumas; but we also found that we could not find anyone more willing—I might say more desirous—to make the sacrifice of time and convenience that was demanded of him in order to do honour to the memory of that great man whose name we are this night met to commemorate. I think, however, that our vote of thanks to M. Dumas for his eloquent address, and for his coming over among us to deliver it, must not be lessened by the consideration that it was impossible for him to surprise us, or at any rate those of us who know him, by any display of eloquence and any display of kindness, however extreme. I call upon you then, with every mark of enthusiasm, once more to show M. Dumas how much you appreciate his kindness in coming among us, and how much you feel the honour of his presence, and the benefit to be derived from his most eloquent address. [Loud and prolonged applause.]

The PRESIDENT: It is unnecessary to put the motion for it has been carried by acclamation.

M. DUMAS replied in a short but eloquent speech, and the President announced that another meeting of the Society would take place at Burlington House, on the 1st of July, when papers will be read by Mr. R. H. Smith and Dr. Phipson.

CHEMICAL SOCIETY DINNER

ON THE OCCASION OF THE INAUGURAL FARADAY LECTURE
BY M. DUMAS, JUNE 18TH, 1869.

In another part of this number we have given an account of the magnificent lecture by M. Dumas. We have here the pleasing duty of giving a brief account of the banquet given to the eminent philosopher and chemist on the evening after the delivery of his inaugural Faraday discourse. As may be supposed, there was a large attendance of Fellows of the Society, all of whom were anxious to do honour to the memory of Faraday, and also to show their esteem and admiration for one who was a personal friend of Faraday, and who occupies one of the highest places amongst our continental scientists. The chair was occupied by the President of the Chemical Society, Dr. A. W. Williamson, F.R.S. The following is the list of stewards:—F. A. Abel, F.R.S.; T. Andrews, M.D., F.R.S.; E. Atkinson; J. Attfield, Ph.D.; J. Lowthian Bell; J. H.

* We have purposely given only a short notice of Professor Dumas's oration, as a verbatim report will appear in our next number.

Brazier; Sir Benjamin C. Brodie, Bart., F.R.S.; A. Bernays, Ph.D.; D. Campbell; F. C. Calvert, Ph.D., F.R.S.; E. T. Chapman; A. H. Church, M.A.; F. Claudet; W. Crookes, F.R.S.; H. Debus, Ph.D., F.R.S.; Warren De la Rue, Ph.D., F.R.S.; F. Field, F.R.S.; G. Cary Foster, F.R.S.; R. Galloway; J. P. Gassiot, F.R.S.; J. H. Gilbert, Ph.D., F.R.S.; J. H. Gladstone, Ph.D., F.R.S.; T. Graham, D.C.L., F.R.S.; G. Griffith; F. Guthrie, Ph.D.; A. V. Harcourt, F.R.S.; D. Hanbury, F.R.S.; C. Heisch; F. C. Hills; T. H. Hills; Dr. Holzmänn; Sir Robert Kane, M.D., F.R.S.; J. B. Lawes, Ph.D., F.R.S.; G. D. Longstaff, M.D.; A. Matthiessen, Ph.D., F.R.S.; J. Mason; H. Medlock; W. A. Miller, M.D., LL.D., V.P.R.S.; T. Morson, jun.; H. Müller, Ph.D., F.R.S.; S. Muspratt, Ph.D.; E. C. Nicholson; H. M. Noad, Ph.D., F.R.S.; W. Odling, F.R.S.; J. D. Perrins; W. H. Perkin, F.R.S.; Lyon Playfair, C.B., M.P., Ph.D., F.R.S.; D. Price, Ph.D.; E. Ronalds; E. Schunck, Ph.D., F.R.S.; E. Schweitzer; P. Spence; R. Angus Smith, Ph.D., F.R.S.; J. D. Smith; J. Stenhouse, LL.D., F.R.S.; A. Smee, F.R.S.; A. Smee, jun.; J. C. Stevenson; C. Tomlinson, F.R.S.; J. L. Thudichum, Ph.D.; R. V. Tuson; J. Tyndall, LL.D., F.R.S.; J. A. Voelcker, Ph.D.; P. J. Worsley; G. F. Wilson; J. Williams; Col. P. Yorke, F.R.S. After the usual loyal toasts, the Chairman eloquently proposed the toast of the evening, "The Health of Professor Dumas," and spoke of his high scientific skill and attainments in terms which were enthusiastically received by the company; and the health of the guest was drunk with the usual honours and amidst tremendous applause. M. Dumas replied in a fluent and brilliant speech, in which he alluded with great pathos and feeling to Faraday, and also spoke of the pleasure it gave him to accede to the invitation of the President and Council to deliver the inaugural Faraday Lecture. Several other toasts followed, which were appropriately acknowledged, and the speeches were interspersed with a selection of music performed by the band of the Coldstream Guards. The arrangements were exceedingly good, and the way in which they were carried out reflects great credit on the executive committee. The evening was a most agreeable one to all present, and we hope that M. Dumas will long remember the delight and enthusiasm with which he was welcomed to the scene of Faraday's labours. We are certain that the Society will never lose the remembrance of his grand and stirring oration, which will always be associated with the courtesy and kindness displayed by the Master of the French Mint during his short visit amongst us. It only remains for us to hope that for many years we may gain as much pleasure and profit from the Faraday Lectures as we have from this—the inauguration of our memorial to England's great philosopher.

PROPOSED MEMORIAL TO FARADAY.

ON Monday last, a public meeting was held in the theatre of the Royal Institution, Albemarle Street, for the purpose of considering what measures shall be taken for the promotion of a memorial to Professor Faraday, whose voice was so often heard as a lecturer within those very walls. The chair was taken at half-past three by his Royal Highness the Prince of Wales, who was supported by M. Dumas, Count Strelecki, General Sabine (the President of the Royal Society), Sir Henry Holland (President of the Royal Institution), Sir Roderick Murchison (President of the Royal Geographical Society), Sir Charles Wheatstone, Professor Williamson, Admiral Manners, Colonel Yorke, Professor Frankland, Mr. De la Rue, Mr. Frederick Pollock, Dr. Gladstone, Mr. Cæsar Hawkins, Dr. Holtzmann, Dr. H. Bence Jones (Secretary to the Committee), Dr. Lyon Playfair, M.P., Professor Tyndall, Professor Graham (the Master of the Mint), Sir John Lubbock, Sir Benjamin Brodie, Mr. Gassiot, Professor Miller, and a number of other distinguished personages,

both English and foreign. The Astronomer Royal, Sir John Herschel, the Marquis of Salisbury, Mr. Layard, and other gentlemen who had been expected, sent letters to apologise for their absence.

The proceedings were opened by His ROYAL HIGHNESS, who, in a few well-chosen words, expressed the pleasure which it gave him, both on public and on private grounds, to preside over such a meeting as the present, and reminded his hearers that, although he whom they had met together to commemorate had been dead for nearly two years, yet nothing had been done by the public as yet to perpetuate his memory. Early in 1868, the Council of the Royal Society requested the President to take measures for the holding of a meeting to promote a monument to Faraday, and, with that view, the Secretary was instructed to write to the presidents of the following societies:—The Royal Society, the Geographical, the Linnæan, the Geological, the Royal Astronomical Society, and the British Association. On the 24th of March, a meeting of the presidents was held, and it was thought desirable, before proceeding further, to learn the views of Her Majesty's Government as to the erection of a monument as a recognition of his pre-eminent services to science and mankind. On the 22nd of June, Mr. Disraeli desired his secretary to say that he considered a monument to Faraday a proper object; but he suggested that its consideration should be left till next year. In the present year, the present Chancellor of the Exchequer wrote saying that he had no doubt of the signal merits of Faraday, and he thought that a monument ought to be erected; but he could not consent to devote public money to a monument for a private citizen, however illustrious. He did not make this rule; he found it. On the 8th of June, it was resolved to hold a public meeting at the Royal Institution. Under these circumstances, the Council of the Royal Society, and the presidents of the various other learned societies, had resolved to take the matter seriously in hand without further loss of time, and the result was the present meeting, at which it gave him the greatest pleasure to take the chair.

The first resolution—"That it is desirable that measures should be taken to provide a public memorial to the late Professor Faraday"—was proposed in a short speech by General SABINE, who said that the Royal Society, over which he had the honour to preside, felt a pride and a pleasure in reckoning Michael Faraday as one of its members, and bore his testimony to the fact that, out of all its long list of Fellows, none had contributed such a valuable collection of papers to the *Philosophical Transactions*.

This resolution was seconded by M. DUMAS, Senator, Member of the Academy of France, and Permanent Secretary of the French Institute. M. Dumas began by reminding his audience that Faraday, whose genius achieved so much in the cause of science, and, therefore, of civilisation generally, was one of the eight Foreign Associates of the Academy of Sciences of the Institute of France. He also said that it was with pleasure he himself had crossed the Channel to do homage to his memory, and that it was with a feeling of profound emotion that he now found himself standing in the place where his late great contemporary had stood so often. M. Dumas declared that in France Faraday commands as many admirers as in England, and that among these admirers the Emperor of the French stands foremost—so much so, indeed, that his Imperial Majesty never loses an opportunity of evincing his regard for the name of the great *savant*, after whom Paris had named a street, and whose discoveries have not only done honour to England, but have been of incalculable service to the interests of the world at large. M. Dumas then proceeded with great eloquence and perspicuity to touch in detail upon some of the scientific achievements of Faraday, and took occasion to observe that his genius, in its various applications of science to practical purposes, was distinguished by originality, not less than by profundity, instancing his condensation of gas into liquids, his manufacture of steel

and of glass, his magneto-electric currents which encircle the world in the telegraph wires, and his magneto-electric light, to be seen in the most important lighthouses of England and of France. M. Dumas wound up his speech by expressing, in a tone of deep emotion, his own personal regard for a man who was singularly distinguished by his virtues in private life. There were many present who sympathised with M. Dumas when he added that the world at large had cause to lament the loss of Faraday as one of the greatest philosophers who ever shed light upon it by the force of genius, but that he himself had still greater cause to lament in his death the loss of a friend.

Sir HENRY HOLLAND moved the second resolution,—“That the following gentlemen be a committee to take the necessary measures for the provision of the said public memorial in honour of Faraday: General Sabine, President of the Royal Society; Sir Henry Holland, President of the Royal Institution; Sir Roderick Murchison, President of the Geographical Society; Dr. Williamson, President of the Chemical Society; Mr. George Bentham, President of the Linnean Society; Mr. T. H. Huxley, President of the Geological Society; Admiral Manners, President of the Astronomical Society; Dr. W. J. Hooker, President of the British Association; the Right Hon. A. H. Layard, M.P., Mr. J. Fergusson, Mr. Gassiot, Dr. Tyndall, Mr. Grove, Dr. Frankland, Mr. De la Rue, and Dr. Bence Jones, with power to add to their number.”

The resolution was seconded by Sir RODERICK MURCHISON, who referred to the fact that in that very theatre, more than 60 years ago, he had seen Sir Humphry Davy make some of those experiments in electricity which now formed the basis of modern science; and that, standing on the very spot where the Prince now sat, Faraday year after year had carried on those experiments after his master's death, training two successive generations of disciples in the study of the laws of nature. He bore willing and grateful testimony to the extreme modesty and humility of the great man who for more than half a century had made that institution his home, and adverted to the fact that Faraday had first shown marks of his high genius within the walls of the Institution in the year 1823, when, Mr. Brande being taken ill and unable to lecture, the duty of lecturing suddenly devolved on his assistant, whose simplicity, sincerity, and genuineness of character even then had begun to make themselves felt, and were but an augury of his after life.

Professor OWEN moved the third resolution, to the effect “That a subscription, not exceeding five guineas in amount from any one person, be made for the provision of a public memorial to Faraday.” He prefaced this resolution by a few remarks, to the effect that the theatre in which they were assembled was redolent of Faraday and seemed haunted by his spirit. Great and deep as was the learning which he displayed as a lecturer, still his profound and subtle generalisations were almost exceeded by that playfulness of wit by which he raised the intelligence of his hearers without lowering himself from the height of his professional dignity. Of his genius they had heard already from M. Dumas; but enough could scarcely be said of his personal merits, his singular modesty, and that unconsciousness of genius which is so often combined with genius of the highest order, as in Wellington. Like him, Faraday sought no honours, and all that he gained came to him unsought; but Englishmen feel that they all have a share in the achievements of both, and the reputation of the great philosopher, like that of the great warrior, is reflected on all his countrymen. Those, therefore, who are devoted to science have a right to call upon not only men of science, but Englishmen in general, to acknowledge and to pay the debt which we owe to Faraday. Let us think what will be the feelings of a future generation who will look back to him as we look back to Newton. His discoveries of the grand secrets of nature have added to our stores of wealth and ministered to our comforts, and hereafter there will arise the feeling

that we have not done as much as we ought for one who has done much for us. He then urged that Faraday and the Royal Institution were standing proofs of the results which could arise out of the voluntary system as opposed to State establishments. Faraday served a voluntary body—a “joint-stock company founded for the purpose of diffusing intellectual pleasure,” and this body whom he served gave him a home in which he might carry out his experiments in the field of science. Late in life had come a public recognition of his services in the shape of a pension and a house at Hampton Court—the latter a free gift for life from his Sovereign. He observed that, as the introduction of the electric telegraph and gas had added to the conveniences and comforts of life, and had helped to diminish crime, the discoverers of such secrets of nature at the very least deserved some reward at the hands of those to whom they ministered—if not from the nation in its collective capacity, at least from its individual members; and he concluded his speech by remarking that, if any member of either House of Parliament should chance to be present there, he ought to take note of the right relations of the nation to men of science.

The resolution was seconded in a few brief but telling sentences by Dr. LYON PLAYFAIR, M.P.

The three resolutions were severally put to the meeting by his Royal Highness, and declared to be carried unanimously.

A vote of thanks to the Prince for his kindness in presiding over the meeting and for his conduct in the chair was proposed by Sir HENRY HOLLAND and seconded by Professor TYNDALL, who spoke with great feeling of the loss which both himself and the nation had sustained in the death of Faraday, and alluded to the fact that on that occasion the Prince had been among the first to write to condole with his widow. The motion was carried with great applause.

Dr. BENICE JONES then read a letter from Sir John Herschel, excusing his absence on the ground of illness; it ran as follows:—

“I grieve to say that I can only be present in spirit at the meeting of next Monday, the state of my health being such as to preclude my leaving home for many months, most anxious though I should naturally be to show every possible reverence and honour to the memory of such a man as Faraday, whom I have always regarded as the “blameless prophet” of British science—so clear and far-reaching was he in his views, so indefatigable in their pursuit, so single in his objects, so blameless in his life, so genuine, candid, and unaggressive in all his relations with his brother *savans*.”

The PRINCE briefly acknowledged the vote of thanks, and assured the meeting that he should be proud to lend his aid to the cause which they had met to promote, and it was announced that subscriptions to the “Faraday Memorial Fund” might be paid in at the Bank of England, Western Branch, Burlington-gardens; the London and Westminster Bank, St. James's-square; to Mr. William Hughes, at the Royal Institution, Albemarle Street; or to any members of the committee.

LABORATORY NOTES.

BLOWPIPE REACTION OF THALLIUM.

WHEN either oxide of thallium is melted with borax, it gives a clear, colourless bead; but when this is kept for some time at a heat much below redness, the outside turns deep brown, owing to the formation of thallic oxide. On raising the temperature, it is again reduced to thallic oxide, small bubbles of oxygen are set free, and the bead again becomes colourless. I am not aware that any other substance behaves in the same manner.

H. C. SORBY.

CORRESPONDENCE.

ARTIFICIAL MANURES:

A COMMON SENSE VIEW OF THE PRECIPITATED PHOSPHATE QUESTION.

To the Editor of the Chemical News.

SIR,—I have perused Mr. Hughes's paper with some interest, but more of astonishment. Is it or is it not the fact, that the greater part of the soluble phosphate of lime supplied to the soil in superphosphates is very speedily converted into precipitated or reduced phosphates, *i.e.*, insoluble in cold water? If it be a fact (and Mr. Hughes will hardly dispute it), why does he ask the manufacturer to make the farmer a present of some 3 to 6 per cent of valuable phosphates, for all intents and purposes of agriculture equal to soluble phosphates? Doubtless, Mr. Hughes is a very good chemist; but, in his zeal in combating the unfair use of oxalate of ammonia as a solvent for *reduced* soluble phosphates, he has rushed off to the other extreme. In his hot haste, and fresh from his "half-hours" of stewing coprolites, first with half their weight, and then with double their weight of oxalate, he rashly seeks to *rob* the manufacturer of his hard-earned soluble phosphates! and, no doubt, the next farmers' club that sends a set of samples to Mr. Hughes for analysis will get them analysed on this principle. Nearly all superphosphates in good condition, from having lain long in the pile, contain more or less of this reduced soluble phosphate. Will Mr. Hughes or Dr. Voelcker contend that, because Mr. Chesshire has used a faulty process (if it be so), and, by boiling for half-an-hour, may have obtained more soluble phosphate from his samples than their respective bulks contained, that therefore the manufacturers are to be fined half-a-crown (or some such sum) per ton for every unit of soluble phosphate which has become reduced in the pile? This is a matter of very serious importance to manufacturers, and one which it behoves chemists, and especially so-called agricultural chemists, to settle.

May I venture to suggest that, if Mr. Hughes will abjure hot water in his examinations for soluble phosphates, he will get more correct results, and, if he had used a cold and very dilute solution of the oxalate, his experiments would then have been of more value. Again—for his own satisfaction, and by way of testing this matter—will Mr. Hughes perform an analysis of the clear solution obtained by pouring distilled water on to superphosphate on a filter; and then let him take another portion of this solution, and *reduce* the whole of the soluble phosphate by precipitating it with ammonia or lime-water. He will then have some precipitated phosphates on which to operate, and, if he will send you his results, I doubt not they will be of some practical value. He will then be able to say the minimum of oxalate of ammonia required to re-dissolve this phosphate, which he now wishes the manufacturer to give to the farmer for next to nothing.—I am, &c.,

FAIR PLAY.

London, June 14th, 1869.

MISCELLANEOUS.

Death of M. Bérard.—We learn from the *Messenger du Midi*, a daily paper published at Montpellier, that M. J. E. Bérard died in that city on the 10th inst., at the advanced age of nearly 80 years. The deceased, a celebrated chemist, was born at Montpellier on the 12th of October, 1789. He was first Professor of Chemistry of the Faculty of Sciences at Montpellier, and held simultaneously the Professorship of Chemistry of the Ecole de Pharmacie established in that city. For about the last twenty-five years he has been, first the active, afterwards honorary, Dean of the celebrated Faculty of Medicine of the University of Montpellier—a post of honour and influence—and he has been well known in various scientific circles. He was a member of several learned societies, the owner of large chemical works, and a man of

independent means—a very courteous, but yet somewhat haughty, scientific diplomatist; he was a staunch upholder of the rights of the Université de France, and, at the same time, in politics a constitutional liberal. Those who have been personally acquainted with him, like the writer of these few lines, can testify that he was an eloquent and highly accomplished lecturer, an eminently successful experimenter, kind and forbearing with the students of his class, who, on an average, numbered from 1100 to 1800.

London Institution.—We have received the report of the above Institution, from which we find that it is proposed to adapt the chemical resources of the Institution to the practical teaching of chemistry. The following is an abstract of Professor Wanklyn's "Laboratory Report for the Session 1868-9":—"In addition to the annexed list of papers [a list of eleven papers follows, abstracts of which have appeared in our columns] from the Laboratory, it should be mentioned that a very elaborate memoir on the alcohols of fermentation, by my friends Messrs. Chapman and Smith, has been laid before a recent meeting of the Chemical Society, and is in course of publication in the "Journal." Much of the recent investigation has consisted in an elaborate confirmation of M. Wurtz's results—a circumstance which is not unimportant, regard being had to the great improvements in method which have been introduced since the date of M. Wurtz's investigation of butylic alcohol. The recent discovery of isomeric forms of the alcohols, and the exceedingly interesting structural differences presented by these isomers, give additional value to a careful study of a natural alcohol, such as butylic alcohol. The Royal Society has testified its approval of investigations such as this by making a grant of £50 to Mr. Chapman for the prosecution of researches of this character. In the paper entitled "*Researches on the Ethers*," read at the meeting of the British Association in Norwich, there is recorded a work in contradiction of a very important set of results published by eminent English chemists a few years ago. The result contradicted is, that an acetic acid had been produced in which part of the *radicular* hydrogen had been replaced by the metal sodium, so as to yield sod-acetic acid, or, more correctly, sod-acetic ether. It has been shown that, contrary to the assertion of two English chemists, there is no driving out of hydrogen by the action of sodium on acetic ether. As a consequence of the disproof of the elimination of hydrogen, a huge superstructure of unsound chemical theory has been destroyed. In conclusion, I would just call attention to the very interesting set of compounds—the salts of the new organo-metal, ethylene-sodium—which have been recently discovered in the laboratory of the Institution, and which are being investigated at the present moment."

Quantity of Water contained in Illuminating Gas.—During the months of February and March of the current year, the author (A. Vogel) instituted on various days, and at different hours during the day and night, experiments with the gas taken directly from the mains of the Munich Gas Works. By causing a slow current of the gas to pass through chloride of calcium tubes, the author found that the quantity of water contained in the gas varied from 0.06 to 0.11 grm. to the cubic foot; it is evident that this quantity may, and naturally will, vary according to circumstances. Dr. Vogel next made a current of gas pass through glass tubes placed in a freezing mixture; in this manner he obtained a quantity of ice formed by the freezing of the water contained in the gas; the water obtained on melting this ice had no action upon test papers. By means of Nessler's test, after previous addition of some caustic potassa to the water, ammonia was very clearly indicated to be present. Cyanogen was found therein by means of Schönbein's test-paper for this substance. When tested with indigo-carmin and sulphuric acid, the decolouration of indigo is observed, while an odour of nitrobenzol is emitted. It hence appears that there is nitrate of ammonia present, and that this is one of the products of the distillation of coal.—*Berichte der Deutschen Chemischen Gesellschaft zu Berlin.*

Testing Bees'-Wax.—It appears that both yellow and white bees'-wax is met with in the trade largely adulterated with paraffin. In order to detect this, the following process is recommended:—2 grms. of the wax to be experimented upon are placed in a test-tube; and there is added a solution, consisting of 1.5 grms. of solid caustic potassa in about 5 grms. of distilled water, and the mixture boiled, care being taken to shake the test-tube now and then, whereby a thorough though not quite clear mixture is produced. When the fluid has cooled so far down as nearly to reach the point of solidification of the wax, from 6 to 8 grms. of light oil of petroleum is gradually added, and this thoroughly incorporated with the entire mass, so as to form an emulsion, from which, if well made, the light oil does not separate. Next, an excess of an aqueous solution of acetate of lead is added, which is mixed with the mass by stirring with a glass rod. The addition of this lead salt causes the separation of the light oil of petroleum, and in it will be dissolved any paraffin present in the wax. The same operation is twice repeated with the contents of the test-tube, that is to say, petroleum is again and again added, and allowed to separate; the separated petroleum is placed into a retort, and the light oil removed by distillation. Pure yellow wax loses, by this process, from 14 to 16 per cent; but wax has been met which lost 57 per cent in weight; the specific gravity of the residue of adulterated wax was 0.88. When it is desired to obtain the paraffin in pure state, freed from any dissolved wax, this may be effected by cautiously decomposing the wax supposed to be adulterated with paraffin, by means of fuming sulphuric acid, which does not affect paraffin.

The Zirconia Light.—The oxygen process of M. Tessie du Mothay, according to the Paris correspondent of the *British Journal of Photography*, consists in heating, in iron retorts divided in two by a horizontal grating, a quantity of manganate of soda. This is heated to a dull red, and a current of superheated steam is made to pass over the mass. Oxygen is given off in abundance, and passes along with the current of steam into a refrigerator, where the steam is condensed into water, and the oxygen is afterwards collected in a gasometer.

When no more gas comes off, the manganate is exhausted. The next operation is to re-oxygenise the exhausted manganate. This is accomplished by passing heated air, not steam, over it, when the manganate absorbs the oxygen, and becomes as ready as ever for yielding it again to the vapour of water. Thus, the two operations can go on for an indefinite time, the air being the source of supply of oxygen. It has been found that carbonic acid gas is detrimental to the production of oxygen, and so the air is deprived of this before it acts upon the manganate of soda. One advantage claimed by the advocates of the zirconia cylinders, besides their durability, is that a mixture of equal parts of oxygen and carburetted hydrogen can be used instead of a mixture in which oxygen is in excess, as is usual. The magnesia for the magnesian cylinders must be very pure, and free from silica, or they will not be durable under heat.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we are endeavouring to effect arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.

Comptes Rendus des Séances de l'Académie des Sciences, Monday, June 14, 1869 (No. 24).

This periodical is entirely filled with the reports about the prizes and the distribution thereof. The greater part of the speaking at this meeting of the Académie devolved upon the eminent and eloquent speaker who honoured the Chemical Society with his excellent speech on the night of Thursday (June 17) at the Royal Institution in London, M. Dumas; and his eminent *confrère* as Secrétaire Perpétuel, M. Elie de Beaumont, read the eulogium on the late M. Puissant, an excellent geodolist and late member of the Académie. Among the prizes distributed we notice the Jecker prize, which has been granted to M. P. A. Favre for his researches on the heat set free by chemical combination; a sum of 2000 francs (£80) has been granted to M. A. Gautier for his researches on hydrocyanic acid, the nitriles, and a new class of substances isomeric therewith.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 196, April, 1869.

Omitting the papers on subjects connected with mechanics and engineering, we meet with a report—

On the New Method of Purifying Oils invented by M. Michaud, of Honfleur; the report is from the hand of M. A. Chevalier. After having reviewed the different processes in use from the middle of last century, to render fatty oils, such as rape-seed and colza oils, more suitable for use in lamps of a more complicated construction, the author of the report states that M. Michaud's process consists of a defecation of the raw oil, by the simultaneous introduction therein of jets of air and thin streams of sulphuric acid, whereby those substances contained in the raw oil, which are injurious to its properties for use in moderator and carcel lamps, are coagulated and brought to the surface of the oil as a scum, which can be easily removed; the oil is next washed with water, afterwards heated by steam to 100° C., and lastly filtered through cotton and a layer of clean and pulverised marble, at a temperature of 40° C., yielding an excellent material for use in lamps.

This number also contains a lengthy treatise—

On Electricity and its Application to the Construction of Electrical Apparatus for Medical Use.

And a lengthy treatise—

On the Cultivation of the Mushrooms known as Truffles.—To this paper are added analyses of twenty-four different kinds of soil taken from various parts of France, but it does not, after all, appear that there is distinct relation between any kind of soil and its capability of growing these dainties, which, as appears from this paper, were largely cultivated in France, for the use of the wealthy Romans, at the time Cicero and Horatius lived. Curiously enough, those parts of France—the native country *per excellentiam* of truffles—which produce good wine, do, as a rule, also produce these cryptogamies in excellent condition.

Annales du Génie Civil, No. 5, 1869.

This periodical contains the following short notices concerning matters of interest to our readers, in addition to its valuable papers relating to mechanical science:—

Artificial Ebony.—This material is prepared on the large scale in the following manner:—60 parts of charcoal, obtained from seaweeds, and previously treated with dilute sulphuric acid, and dried, are ground to powder, and mixed with 10 parts of liquid glue, 5 of gutta-percha, and 2½ of caoutchouc, care having been taken to mix the two latter substances with coal-tar oil, and thus to render them gelatinous; next 10 parts of coal tar, 5 of pulverised sulphur, 2 of pulverised alum, and 5 of powdered resin are added, and the mixture heated to 300° F. After having been cooled, a substance is obtained, which, in every respect, is equal to genuine ebony wood, but is far less expensive, and takes a finer polish.

Vulcanisation of Caoutchouc.—In a great many instances, especially when a superficial vulcanisation only is desired, bisulphide of carbon and chloride of sulphur only are applied. Since the bisulphide is very inflammable as well as very volatile, and is, beside this, injurious to the health of the workmen, it is desirable to desist from its application; instead of it, petroleum is now used, after having been submitted to a peculiar process of refining; it is for that purpose mixed with sulphuric acid, thoroughly stirred, and, after having been left quiet for some time, the supernatant oil is withdrawn by means of a syphon, and placed in distilling apparatus along with some caustic potassa, and submitted to distillation. The refined petroleum thus obtained is, however, a less good solvent for caoutchouc than the bisulphide of carbon, and hence the vulcanisation process may, by the use of petroleum, become less complete and less penetrating than by the use of the bisulphide of carbon.

Manufacture of Phosphorus.—M. Brison proposes to apply for this purpose, on the large scale, a furnace not unlike a blast furnace as used for the reduction of iron ore. Through a kind of throat or mouth, which can be hermetically closed, coke and phosphate of lime, either apatite, coprolites, or any other, are introduced, along with a sufficient quantity of a suitable flux to liquefy the lime of the phosphate and the ashes contained in the coke. A blast-pipe, connected with a blowing engine, introduces a sufficient supply of air to keep the coke, after having been ignited at a high temperature, while a tube, plunging into a tank, filled with cold water, is intended to carry off the vapours of phosphorus set free by the reducing action of the coke upon the phosphate; the slag is run off in a peculiar manner, somewhat akin to that in use with blast furnaces at iron works, but so as to prevent phosphorus escaping. According to a note by the editor of the paper at the head of this notice, the results obtained with this furnace are very satisfactory.

Les Mondes, June 3, 1869.

Newly-Invented Gunpowder.—A Bavarian chemist, named M. Hahn, has brought to Paris a proposal to sell his invention of a new kind of gunpowder, which, according to his statements, is so readily prepared, that one workman, while engaged for ten hours a day, can mix 200,000 kilos. (200 tons) of the materials the powder is to consist of, which are substances readily procurable in any country. This powder, on being ignited, gives off no smoke, and is neither affected by damp nor dryness, and can be safely stored anywhere. We refrain from quoting more about this subject, as we fear *le bon Père Moigno* has been taken in somewhat, as would appear from the statement that this powder, while floating on water, yet explodes in contact therewith, and is not after all affected by damp (*sic*).

Boiling of Sugar.—M. Woestyn.—The only noteworthy point in this rather practical paper is the observation, made by the author, that, notwithstanding the use of the vacuum pan, by the application of steam of 1, 2, 3, 4, or 5 atmospheres over and above the atmospheric pressure, and corresponding to temperatures of 100°, 122°, 134°, 143°, and 152° C., an increase of colouration, averaging 2, 4, 8, 12, and 16, is obtained, while, at the same time, research with the *saccharimètre optique* proves analogous quantities of inverted sugar in the product previous to the boiling free therefrom.

Among the books of which receipt is acknowledged we notice an Italian monograph, by M. A. Raffaele Drago, which bears the title—*"Resumé of the Theory of the Rev. Father Angelo Secchi, S.J., on the Relation existing between the Meteorological Phenomena and the Variations of Terrestrial Magnetism."* This book is highly spoken of in the above-named periodical, which contains a lengthy paper, "On the Phosphorescence and Luminosity of Gases under Reduced Pressure," translated from the Official Gazette of the Kingdom of Italy, this paper, however, does not contain anything on this subject which is not already known to our readers.

June 10, 1869.

The only communication we briefly notice from this number is:—

Localities of Rock Salt.—Dr. A. Boué.—The author says: The ten or twelve large sites of rock salt at present known belong, in a geological sense, to either secondary or tertiary formations; those of the Devonian and Silurian deposits appear to have been formed by the evaporation of their existing seas, by the action of the heat of the interior of the globe. The saline deposits and beds of gypsum of triassic period are neither due to evaporation or sublimation, and appear to have been rather formed by saline waters, saturated solutions of salt, from springs, running into then existing seas, and causing such a supersaturation as to bring about a deposit of chlorides and sulphates. The saline springs, salt springs of the cretaceous period may be the result of fresh water which has become saturated with salt while traversing deeper lying beds thereof, and being afterwards forced up by hydrostatic pressure. It may be said that a continuous diminution of sea-water has been taking, and is yet actually taking place, from the first existence of a sea on our globe, either by chemical action, or by infiltration,

PATENTS.

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1523. W. Benson, Hexham, Northumberland, "Improvements in treating or reducing ores, and in apparatus employed therein."—Petition recorded May 18, 1869.

1632. F. A. Barrow, Glasgow, N.B., "Improvements in purifying or bleaching mineral oils."—May 27, 1869.

1642. J. Brönnner and H. Gulzkow, Frankfort-on-the-Maine, "An improved method of obtaining anthracen out of asphaltos—that is to say, pitch produced from coal-tar—and of preparing two colouring matters from the anthracen."

1652. A. T. Fairgrieve, West Street, Sunderland, "An improved paste or composition adapted for coating the bottoms of wood and iron ships."—May 28, 1869.

1668. P. Kirk, Workington, Cumberland, "Improvements in puddling furnaces, and in other furnaces employed in the manufacture of iron and steel."—May 31, 1869.

1691. H. Browning, Salmon Lane, Limehouse, Middlesex, "Improvements in compositions suitable for use as varnish or paint."—June 1, 1869.

1700. G. V. Turnbull, C. Salvesen, and R. Irvine, Leith, N.B., "Improvements in the manufacture or preparation of lubricants or softeners, and the application of the same to the treatment of hemp, jute, flax, and other like fibrous materials."

1706. H. Larkin, Torriano Cottages, Leighton Road, and W. White, Thurlow Road, Hampstead, Middlesex, "Improvements in the manufacture of magnesium, and in the preparation of its anhydrous chloride."

1710. A. L. Simpson, Stowmarket, Suffolk, "Improvements in compositions suitable for treating sheep attacked by fly, and for other similar purposes."—June 2, 1869.

NOTICES TO PROCEED.

318. W. J. Palmer and W. P. Goulding, Reading, Berkshire, "Improvements in evaporating and calcining alkaline solutions which have been used to boil vegetable fibres."—Petition recorded February 2, 1869.

362. J. Halford, Kingswinford, Staffordshire, "Improvements in puddling furnaces used in the manufacture of iron, and in other reverberatory furnaces."—February 5, 1869.

419. P. Taysen, Leith, "Improvements in the manufacture of stearic and oleic acids."—A communication from J. C. A. Bock, Copenhagen, Denmark.—February 10, 1869.

460. A. H. Lewis, Fenwick Street, Liverpool, "Improvements in extracting copper from its ores."—A communication from T. S. Hunt, Montreal, and J. Douglas, jun., Quebec, Canada.—February 15, 1869.

510. E. Dorsett, London Street, London, "Improvements in means and apparatus for heating, smelting, and working metals, and in furnaces employed therein, which improvements are also applicable to heating and otherwise operating upon minerals and other substances."—February 19, 1869.

699. J. P. Budd, Ystalyfera, near Swansea, Glamorganshire, "Improvements in the manufacture of iron and steel."—March 8, 1869.

727. G. Spencer, Cannon Street, London, and J. Barker, St. Leonards, Mortlake, Surrey, "Improvements in preserving animal substance, fruits, and other substances, made from corn, grain, or other vegetable matter."—March 9, 1869.

1044. W. T. Rickard, Crown Court, Threadneedle Street, London, "Improvements in the preparation of cements."—April 7, 1869.

1418. H. R. Lumley, St. John's Wood, London, "The treatment of molten iron in order to free it from all impurities."—May 10, 1869.

1568. G. Johnston, San Francisco, California, U.S.A., "Improvements in the distillation of spirituous liquors, and in apparatus to be employed therefor."—May 20, 1869.

NOTES AND QUERIES.

Superphosphates.—Probably some of your chemical correspondents would tell me if, in superphosphates, a chemist can say whether it has been made from bone material or mineral phosphate, either wholly or mixed. I am in the way of selling and buying such, and buy according to the quantity of soluble and insoluble phosphates present. I wish to buy nothing but bone material. According to Dr. Anderson and other agricultural chemists, the phosphates in mineral is of much less value than in bone this last season; the phosphate in mineral was sold at 10d. per unit per ton, while that in bone-ash was 1s. 5d. per unit per ton. I buy at the rate given for phosphates in bone-ash. I have sent to a number of chemists for analysis samples of my manure, and get often very irregular results from the same lot; but in no case can I be informed whether the manure has been made from bone-ash wholly, or only partly, and how much of the one and the other. Is this problem within the range of ordinary analysis? If not, what guarantee have farmers that they are not paying for an article they do not get.—A CONSTANT READER OF THE CHEMICAL NEWS.

Albumen.—It frequently happens that among the dried albumen met with in commerce a variety is met with which is soluble in water,

but not coagulated by the application of heat. Dr. Monnier, at Lyons, has succeeded in preparing this modification, and has studied its properties. When white of eggs is slowly evaporated by exposure to the heat of the sun, or rapidly evaporated to dryness on a water bath, after having been previously exposed to strong daylight for a considerable length of time, a modification of albumen is obtained, non-coagulable by heat. A dilute aqueous solution of this non-coagulable albumen is not precipitated by addition of acetic, formic, or tartaric acid, but the addition of these acids (a few drops) restores its coagulability by heat. In order to restore to 0.20 grm. of this dry albumen dissolved in 10 c.c. of water its coagulability by heat, it was sufficient to add 5 milligrammes of solid crystalline acetic acid, dissolved in 0.5 c.c. of water. If as much ammonia was added as exactly suffices to neutralise the acid, the albumen thereby again lost its property of becoming coagulated by the application of heat.—*Deutsche Industrie Zeitung*.

Rendering Walls Impervious to Damp.—This is not a very simple question; well-built walls of proper construction ought not to be damp: the causes of dampness may be—(1) bad foundation in a wet or ill-drained soil too impervious for water, and the use of unsuitable building materials, *i.e.*, too porous bricks or natural stone; (2) walls may be damp because on being exposed to rain, and made of materials which greedily absorb and retain water, they slowly but surely allow it to evaporate where the heat is greatest, *viz.*, on the inner side; (3) damp walls may be due to the infiltration of water from drains, as well as from improperly-constructed gutters along the roof, and rain-water pipes. Really sound building materials, well-seasoned stone and sound bricks, laid in a proper cement and upon a suitable foundation, concrete if necessary, and application of coal tar or even asphalt will insure against defects of soil wherein foundation is laid, especially if care be taken about proper drainage pipes. As to covering, coating rather, walls inside with materials to resist damp there are various means at hand. Supposing due care to have been taken in building the wall, and good materials to have been used, it may be coated with a thin layer of good Portland cement, mixed with a little plaster of Paris, and, after this is thoroughly dry, it may be hardened, and rendered impervious to water by painting it with boiled linseed oil and red-lead mixed together. If it is required afterwards to have a kind of stucco laid on, it not being intended to paper the wall, such stucco may be made up—(1) of gypsum, plaster of Paris mixed with a thin glue solution, to which a small quantity of sulphate of zinc has been added, constituting, after drying, a hard surface, which can be rubbed smooth with pumice-stone; (2) or a paint is used, made of 50 parts of fine white sand, similar to that used in glass-making, 50 parts of marl, 9 of massicot, litharge, and 9 of red-lead, mixed with $4\frac{1}{2}$ quarts of boiled linseed oil. Water-glass, or silicates of soda or potassa, have not been found to answer well: perhaps Szerelmey's silicate zopissa might answer the purpose.

TO CORRESPONDENTS.

* * *In consequence of the enlargement of our journal by the introduction of abstracts of all the foreign periodicals, the index is much larger than it has hitherto been; we have therefore decided to issue next week a supplementary number, which will contain the title-page, preface, and a copious index to the present volume. The price will be the same as for an ordinary number. Unless advised to the contrary, that number will be forwarded to subscribers with the first number of the next volume, to be published on Friday next.*

A. B. E.—Our correspondent will find in No. 488, April 9, 1869, p. 178, the information he asks for.

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